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MACHINERY

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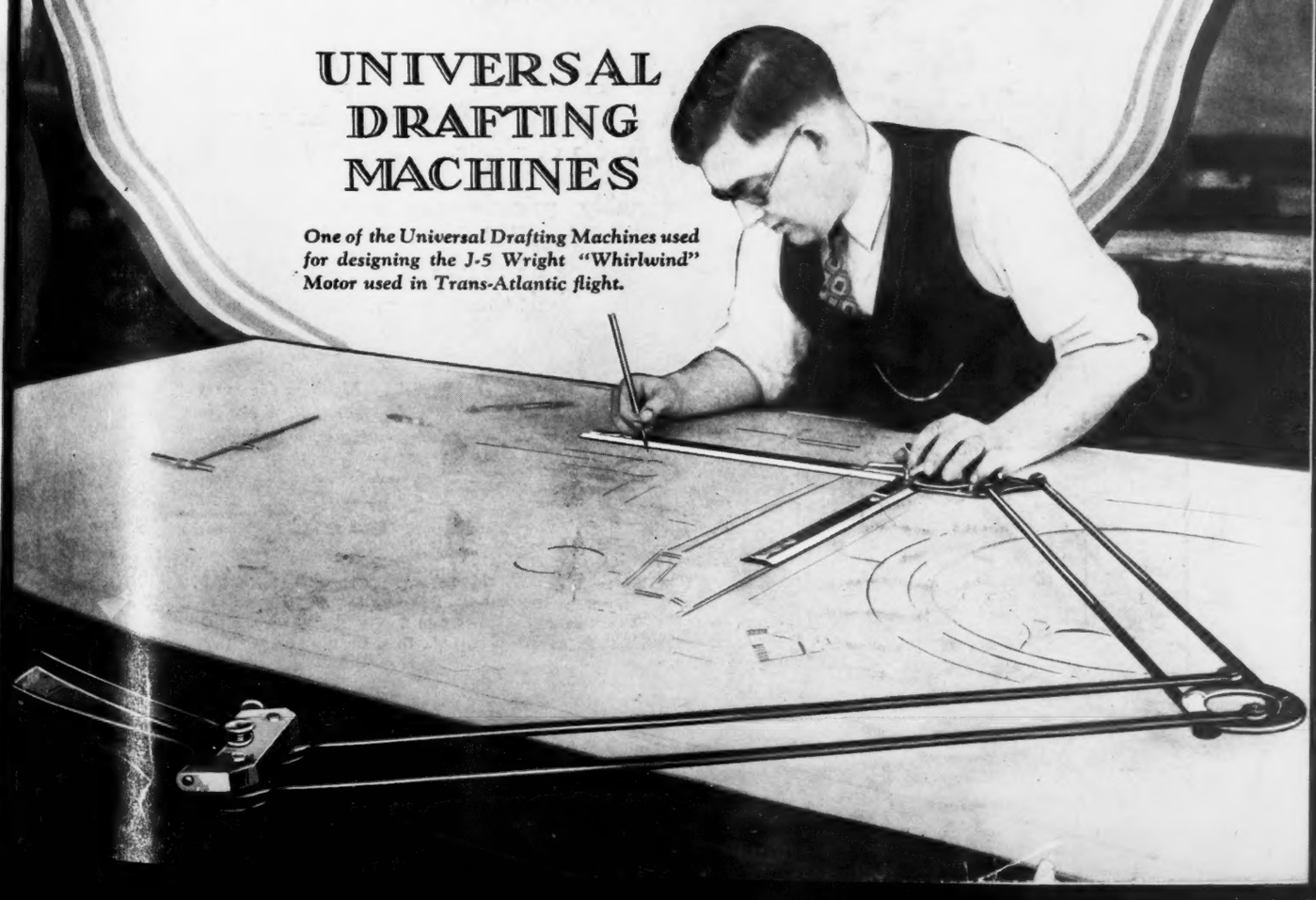

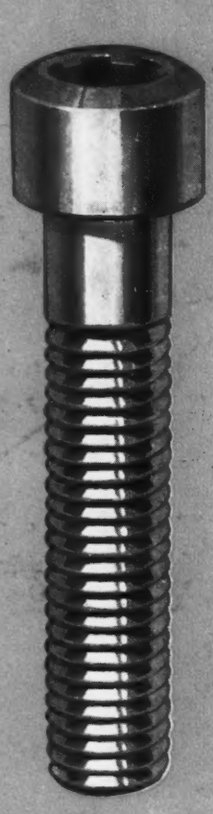

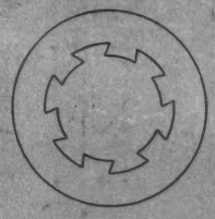

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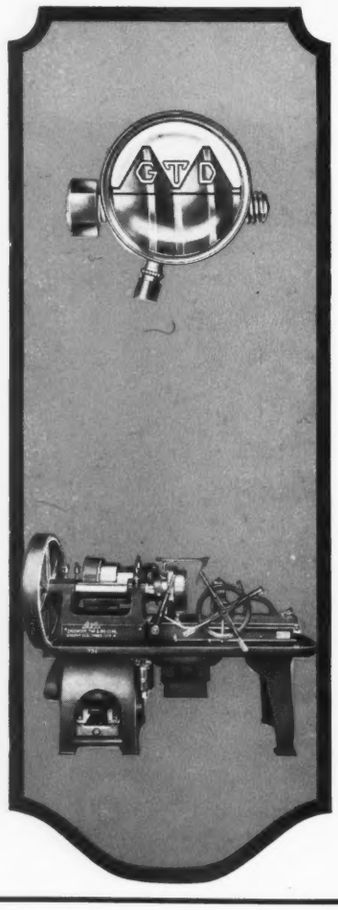

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MACHINERY

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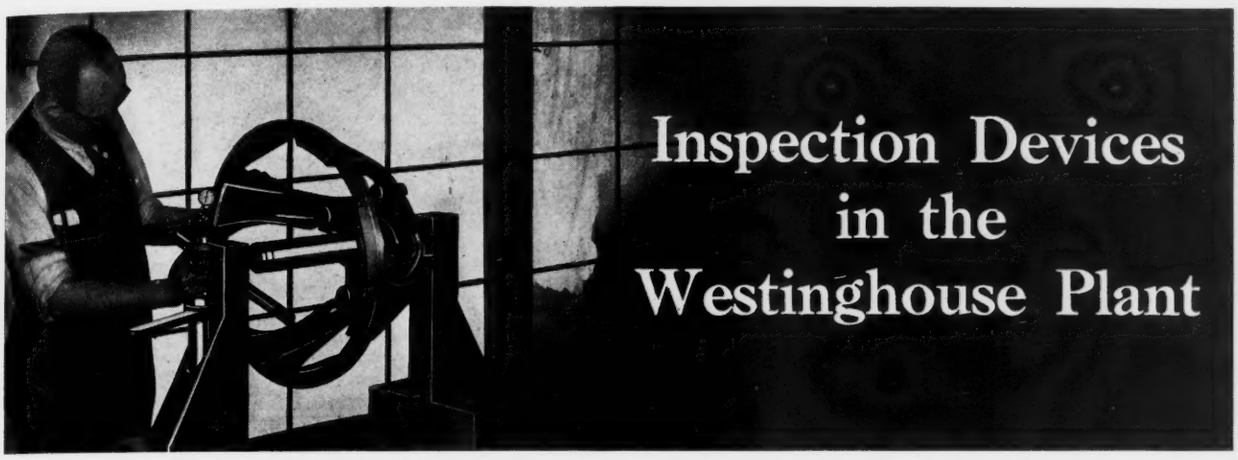


Inspection Devices in the Westinghouse Plant

By WILLIAM H. MILLER, Supervisor of Tools, Inspection Department, Westinghouse Electric & Mfg. Co.

HAVE you ever stopped to think how many gages and inspection devices are required in a large plant manufacturing an almost endless variety of accurate machinery? In the East Pittsburg, Pa., plant of the Westinghouse Electric & Mfg. Co., which comes within this classification, there are approximately 8000 different special gaging devices. A great many men are constantly engaged in keeping these devices in working condition and in designing and making new inspection equipment to meet the needs of the shop. This, and a second article, will describe a number of the more interesting examples of gaging equipment used in the plant mentioned.

Testing the Concentricity of Motor End Brackets

The heading illustration and Fig. 1 show equipment employed for checking the finished periphery of flange *A* on motor end brackets. This flange surface fits into the motor housing and must be concentric with the bracket bore within close limits.

For the inspection, the end bracket is mounted on a long slightly tapered mandrel *B*, which is then placed between the centers of uprights *C* and *D*, upright *C* being adjustable along the inspection table to suit the length of the mandrel. It can be conveniently clamped in various positions on the table and its center adjusted into the center hole of the mandrel.

Fastened to this upright is a bar *E*, to the outer end of which bar *F* is attached. Bar *F* is provided with a dial indicator at the forward end, and this indicator is connected to a roller which is placed in contact with flange *A*. Hence, the inspection is accomplished by merely rotating the mandrel to carry the entire flange periphery past the indicator. Bars *E* and *F* are adjustable to permit the indicator to be positioned both radially and longitudinally, as required. This equipment can also be used for testing the finished face of the work.

WILLIAM H. MILLER has been supervisor of tools and gages at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., for eighteen years. Mr. Miller was born in Pittsburg in 1873. His preliminary education was obtained in the Pittsburg public schools. Later, while learning the trade of toolmaking, he attended evening school and then took several courses with the International Correspondence Schools. In 1892, Mr. Miller entered the Westinghouse organization as a toolmaker, and after eight years was made foreman of tool inspectors and inspector of production in the inspection department. In 1909 he assumed his present duties. Mr. Miller was also employed in the Mansfield Brass Works for two years and in the Pittsburg and Western Railroad Shops for a similar period.

Checking the Parallelism of Keyways

In Fig. 2 is shown a combination adjustable gage which is employed for checking the parallelism of a keyway in the bore of commutators in relation to the copper bars which compose the commutator. This gage has a round bar which is contained in slide *A*. Interchangeable keys of different widths may be fastened in this bar to suit the keyway in the commutator. After the key has been located in the keyway, slide *A* is drawn back in the bore to cause the bar to center itself. Then the parallelism of the keyway in relation to the copper bars can be determined by pulling pointer *B* up and down, with the indicating end in contact with a copper bar. Pointer *B* is fastened to rod *C*, which extends through slide *A*.

Fixture Used for Finding the Angles of Gages

Various angles on commutator spiders or bushings are checked by means of gages of the type shown at *A*, Fig. 3. This illustration shows the inspection device employed for determining the accuracy of the gages themselves. A master plate *B* corresponding to the angles of one of the vees in the gage is first clamped to carriage *C*, which can be accurately raised and lowered on ways of the column by revolving micrometer screw *D*. The edge of

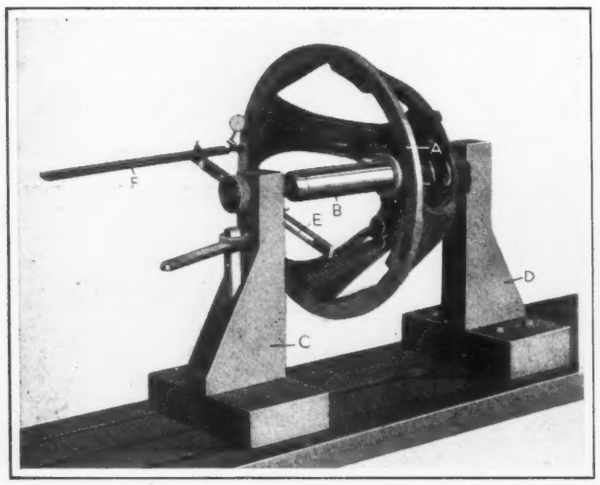


Fig. 1. Equipment Used for Checking the Concentricity of the Flange on a Motor End Bracket

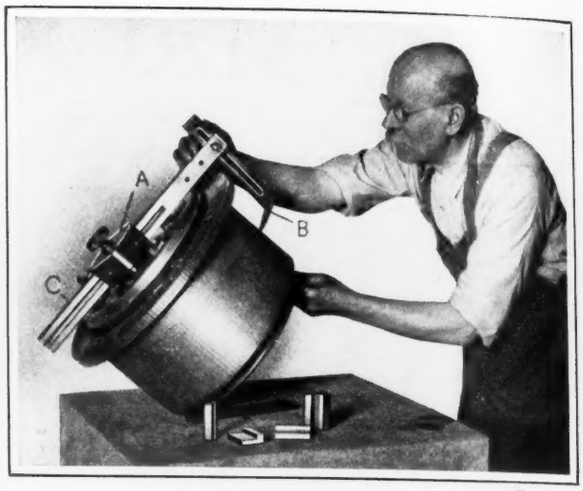


Fig. 2. Determining the Parallelism of a Commutator Keyway with the Copper Laminations

the gage which contacts with bar *E* is also tapered, and so this bar is arranged to be slanted the proper amount through the adjusting screws. In checking a gage with this equipment, the master *B* is positioned to the proper height, and bar *E*, to the proper angle and height. The corresponding surfaces of gage *A* should contact with master *B* and bar *E* without light showing between them.

Inspecting Gas Engine Pistons

Gaging fixtures employed in checking various dimensions of pistons used in farm lighting equipment are illustrated in Figs. 4 and 5. The fixture shown in Fig. 4 is used to determine the concentricity and parallelism of the outer surfaces in relation to the center line. The skirt is seated on a large cone which is mounted on a ball bearing to permit easy revolution. The closed end is held in an overhead center backed up by a spring. Dial indicator *A* is employed for checking the concentricity, while the indicating device *B* is used to check the parallelism of the wall with the center line. The pointer on this indicating device is fastened to a holder which may be swiveled to determine the amount of error in a piston.

The device illustrated in Fig. 5 is employed for checking the squareness of the piston-pin holes relative to the sides of the piston. This device is first set up by slipping block *A* over spindle *B* until the block comes in contact with swivel lever *C*. The outer end of this lever is in contact with the pointer of indicator *D*, so that when the block comes in contact with the lever and the latter swivels in conformity with the block, the indicator can be set to zero.

The block is then removed from spindle *B* and pistons may be positioned on the spindle as shown, being pushed along the spindle until the side comes in contact with lever *C*. Contact between this lever and the piston must occur at three different points along the piston wall. Any deviation in the squareness of the piston-pin holes with the piston side will be immediately indicated by the position of the needle on the indicator *D*.

The three pins *E* fastened to the fixture base are employed in determining whether or not the piston-pin holes are in the center of the piston. The piston-pin holes are merely placed over the largest of these pins, and if the piston passes between the two smaller pins, the holes are central.

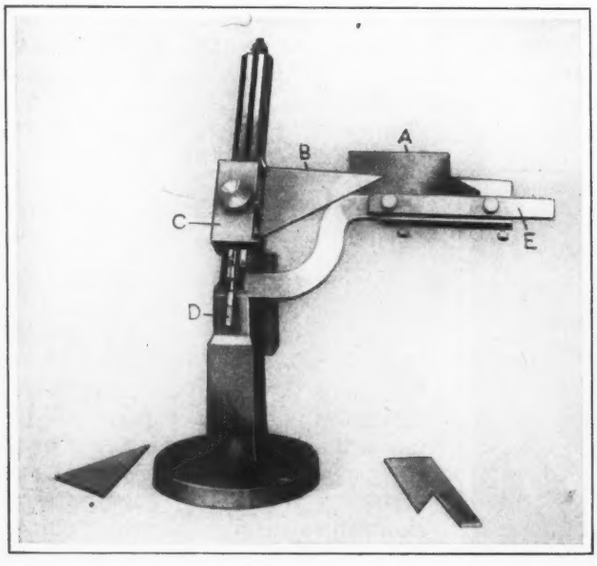


Fig. 3. Fixture Employed in Determining the Accuracy of Various Angular Gage Surfaces

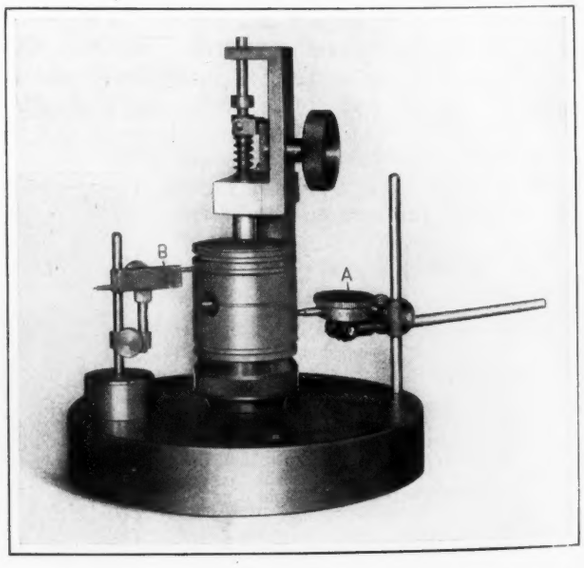


Fig. 4. Fixture for Determining the Concentricity and Squareness of Gas Engine Pistons

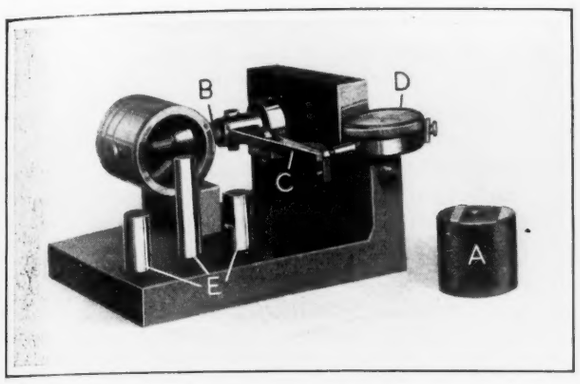


Fig. 5. Checking Squareness of Piston-pin Holes with Side of Piston

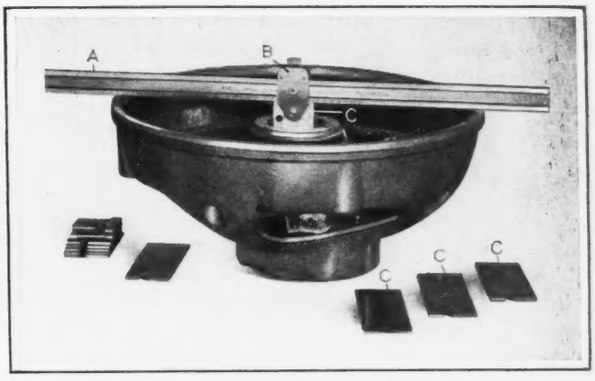


Fig. 6. Depth Gage Provided with Interchangeable Measuring Plates

Determining the Depth of a Counterbored Hole

Inspection equipment employed in checking the depth of the counterbored seat in a motor end bracket from the face of the bracket is illustrated in Fig. 6. This device consists essentially of an accurate straightedge *A* to which a slide *B* is fastened. Interchangeable accurately ground plates *C* can be attached to this slide to suit the distance from the side of the straightedge in contact with the housing to the face of the seat. Plates *C* are of the limit gage type with "Go" and "Not Go" contact edges.

Device Employed in the Inspection of a Crankshaft

The parallelism of the wrist-pin bearing of a single-throw crankshaft in relation to the main bearings is determined by means of the fixture shown in Fig. 8. The crankshaft is first set up with the ends supported by the centers of a stationary headstock and adjustable tailstock. Then rests *A* and *B* are adjusted accurately against the main bearings, after which the two centers are drawn back. Small rollers are provided where these rests come in contact with the main bearings.

Before the crankshaft is placed on the fixture, however, a hinged block *C* with a long hardened pin *D* fastened to it, is clamped to the crankpin bearing. After the crankshaft has been placed in the fixture, pin *D* is held in contact with ground surfaces of blocks *E*, and by observing the contact of the pin with these surfaces and using feeler shims, the trueness of the crankpin bearing can be determined as the crankshaft is revolved.

Feeler gages of the "Go" and "Not Go" type are also employed, when the crankshaft is set up as illustrated, for checking the throw of the wrist-pin bearing from the base of the fixture.

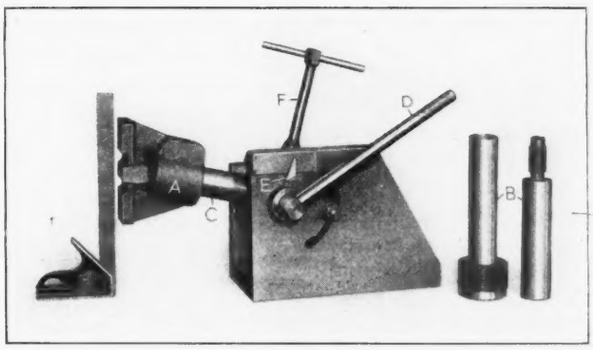


Fig. 7. Device Used for Determining the Angle Between the Center of a Threaded Hole and a Base Surface

Gage for Finding the Angle of Foot Castings

Fig. 7 shows an interesting device employed for determining the angle between the base surface and a threaded socket on foot castings such as shown at *A*. An interchangeable threaded mandrel, such as shown at *B*, is mounted in the device, as illustrated at *C*, and the work is screwed on this mandrel. The opposite end of the mandrel is held in a block, mounted on a shaft that can be swiveled by means of handle *D*. Pointer *E* is fastened to the same shaft and passes over a plate which is graduated in degrees.

After the work has been screwed on the mandrel as shown, it is a simple matter to swivel handle *D* until the base of the casting is true vertically with

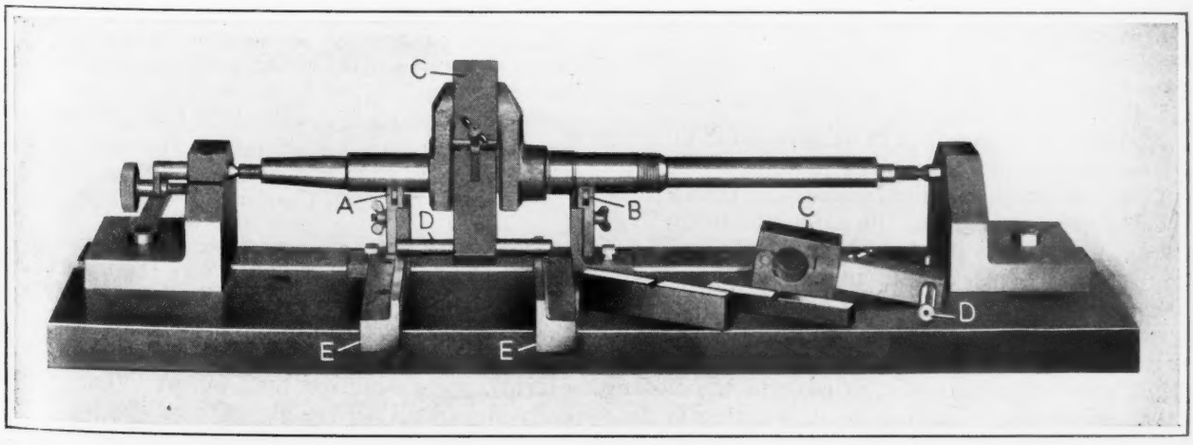


Fig. 8. Inspection Fixture Used in Checking the Parallelism of a Crankshaft Pin Bearing with the Main Bearing

a combination square positioned on the surface plate as shown. By then observing the graduation which pointer *E* indicates, the desired angle is readily determined. Handle *F* provides a convenient means of locking mandrel *C* in any desired setting.

* * *

DRYING MOLDS BY ELECTRICITY

The methods generally used for drying foundry molds either require considerable time or are wasteful of heat, or both. Some time ago the Gleason Works of Rochester, N. Y., made an investigation to discover the best method of drying molds, and the results obtained have been described by Frank C. Taylor in an article published in the *Gas and Electric News*. It was found that not only can electricity be used for drying foundry molds to advantage, but apparently it is the best source of heat to use for this purpose.

The heaters used in drying the molds are approximately 18 inches long and 1 1/2 inches in diameter. For normal use, six of these heaters are tied together in an iron frame and operated in series on 230 volts, alternating current, taking approximately 32 amperes, or a total kilowatt capacity of 7.36 kilowatts. Current is supplied to the heaters through asbestos-covered wire connected to a two-wire rubber-covered cable, and connection is made to the supply by means of a Kliegl, 50-ampere, two-wire, stage plug connected, in turn, to a 60-ampere, two-wire Trumbull safety switch. Ordinarily one of these six unit heaters is suspended from rods placed on top of the mold, resting upon the flask. No part of the heater is in contact with the mold; consequently no damage is done to the surface. In some cases, where the mold is particularly deep at a certain point, single heater units are dropped down into the cavity.

After the heaters are in place, electrical connections are quickly made by the use of plugs, then bricks are placed on top of the lower half of the mold and the upper half of the mold placed on top of these bricks. The separation of the upper and lower halves of the mold gives more room for the electrical heating unit, room for the asbestos wires, and an outlet for the moist air as well as an inlet for the dry air from the room.

For a flask 48 inches wide, 48 inches long, and 36 inches deep, it is ordinarily necessary to have the heat on for from two to four hours in order to dry the mold sufficiently. Translating this into kilowatt-hours, from 15 to 30 kilowatt-hours are required to dry a mold of this size. The advantages claimed for this method are:

(1) The flask does not have to be moved after the pattern is removed. (2) It is possible to spray the surface of the mold with plumbago and talc, so as to obtain an excellent surface in the casting. (3) The even strength of the mold, due to the even drying, gives a casting but slightly different from the pattern. This results in less chipping, and easier painting. In the case of painting, if the surface is rippled, it is necessary to fill in the casting with filler which is softer, of course, than the iron. (4) A mold may be made, dried, and the casting made, in one day. This results in a saving of floor space and makes possible a day's saving on rush work, which often is an important item.

TEN PRINCIPLES FOR STANDARDIZATION

By G. M. BARTLETT, Consulting Engineer, Diamond Chain & Mfg. Co., Indianapolis, Ind.

The purposes of standardization are economy and convenience as affecting the designer, the manufacturer, the merchant, and the consumer of the article in question, both now and in the future.

These benefits of economy and convenience are brought about by:

(a) A reduction in the number of sizes or models of a given article for which tools and materials have to be kept on hand.

(b) Interchangeability of parts produced by different makers.

(c) Convenience in obtaining the sizes desired directly from stock.

(d) Lower cost of producing articles.

The following ten principles have proved to be valuable guides for those engaged in the work of establishing national standards in the mechanical arts:

1. Follow good principles of design. This means that the standardized article should represent good engineering, and its design should be such as will stand the criticism of technical men everywhere.
2. Reduce the number of sizes to a reasonable minimum, and make use of the "preferred number system" (sizes running in approximate geometric series) as far as possible.
3. Select sizes, wherever feasible, from those now in use.
4. Provide for the interchangeability of articles of different makes wherever economy and convenience call for it.
5. Be practical, and do not propose standards that are unlikely ever to be adopted, or that cannot be adopted within a reasonable period.
6. Do not reject a desirable standard merely because it will take eight or ten years to adopt it.
7. Build for the future. Establish standards that future generations will not want to change. Do this even at the expense of a little temporary inconvenience to a manufacturer or a consumer.
8. Do your work independently of particular commercial interests. Standards are for the good of the whole and not for the temporary accommodation of any one or two commercial organizations. If they are good standards, they will eventually benefit all classes.
9. Do not carry standardization too far. The purposes of standardization are economy and convenience. The work should not be carried so far as to close all the doors to further improvement in design.
10. Do not carry out one or two of these principles at the expense of others that are of equal importance.

* * *

During 1927, the average load per train on the railroads of the United States was the highest ever reported—approximately 3 per cent greater than the best previous record. This means that fewer locomotives, in proportion to the amount of traffic carried, were required than before. The average daily movement per freight car was also the highest ever attained, and the conditions of cars and locomotives the best ever reported.

Qualifications of a Foreman

By E. H. FISH

MOST foremen were good workmen before they were made foremen, and most of them think of themselves as super-workmen. Their employers think of them as part of the management. Therein lies a wide gap which neither the foreman nor the employer has done a great deal to bridge. These observations are the result of considerable experience with foremen both in the shop and in the class-room.

During the last few winters, the writer has conducted university extension classes for foremen. The first 200 or 300 foremen met in this way gave the impression noted. The last 250 foremen (or 248, to be exact) with which the writer came in contact put their ideas of desirable attributes of a foreman in writing, so that they could be analyzed.

What Qualities are Most Valuable in a Foreman?

The 248 foremen were asked to write down, after careful consideration, the necessary and desirable qualities of a foreman, and then list them in the order of their importance. The result is given in the accompanying table. The first column gives the number of foremen who rated each one of the twenty-eight qualifications listed as most important. This column does not foot up 248, as some of the men gave a dozen qualifications as equally important.

How Foremen Rate their Own Qualifications

	First	Among First Seven	Mentioned
Courtesy	0	14	36
Memory	0	18	45
Sympathy	0	39	141
Energy	1	43	106
Patience	1	13	40
Cooperativeness	1	40	125
Ambition	1	12	28
Initiative	1	23	28
Self-control	2	39	105
Tact	2	39	117
Desire to study	2	25	138
Appearance	2	23	193
Teaching ability	3	73	157
Loyalty	3	39	76
Resourcefulness	3	62	109
Personality	3	17	42
Ability to plan	5	57	108
Firmness	6	83	172
Responsibility	6	34	60
Knowledge of men	7	57	91
Intelligence	7	10	10
Judgment	9	50	69
Leadership	11	52	65
Honesty	12	41	53
Reliability	16	96	154
Fairness	19	137	222
Health	20	52	100
Technical knowledge	66	125	166

Machinery

Nine men overlooked the request that instead of listing character as a quality, they list the things which make up character. Accuracy, courage, foresight, orderliness, self-confidence, care, appreciation of quality, and knowledge of other departments, divided the remainder of the list. The second column in the table shows the number of men who placed the given quality in the first seven items of their lists. The last column gives the number of men who listed the specified quality at all.

Each man who wrote down his ideas had a text-book which listed leadership, reliability, character, firmness, fairness, sympathy, teaching ability, and the desire to study as the most important requisites for a foreman. How this advice in the text-book affected the men's replies is shown by the table.

A meeting at each of the shops concerned, following the handing in of the papers, was devoted largely to a discussion of the replies. These discussions brought out some interesting things which were rather surprising to the writer, and which may be surprising to employers as well.

The answers were not confined to any one trade; there were machinists, to be sure, but there were also printers, paper box makers, shoe makers, makers of tennis rackets, rubber shoe makers, candy and toy makers, jewelers, leather belt makers and all the trades which go with these. There was also a sprinkling of technical college men who held management positions and about twenty superintendents.

One of the surprising things is that so many qualities commonly considered important in a foreman received so little notice. Less than 20 per cent of the men listed courtesy, memory, ambition, patience, initiative or personality. Discussion showed that courtesy is considered a feminine trait not compatible with the dignity of the job. The belief is prevalent that initiative and ambition are not wanted by the management.

Limiting the Foreman's Responsibility

Foremen in large shops have seen one function after another taken away from them. They see production and planning boards and employment offices adopted, and they wonder what there will be left for them to do. There seems to be but few shops where the management does anything to dispel this apprehension. There are meetings of foremen, but members of the management talk and the foremen are mute except for an occasional "yes sir," the remarks of a few men who always like to talk, boiled down, amount only to another "yes." In one shop it developed that the foremen had renamed their conference so persistently that they had forgotten that it was a conference. They simply called it the "monthly bawling out," and it was evidently well named.

How Foremen Themselves Rate Personality, Character, and Leadership

Personality received little attention, but it developed that the foremen had little to direct their attention to it. They think of personality as belonging to presidents, orators, and actors, but not as anything of value to them. They seem willing to

believe that it is worth while, however, when their attention is called to this quality. Of the few men who listed it at all, there were 17 who put it in the first seven, which is a hopeful sign.

Another group still low in the scale is that comprising honesty, responsibility, leadership, judgment, and loyalty. These are listed by fewer than 40 per cent of the men. Honesty is so generally considered an essential that many men omitted it as being trite. Responsibility is thought by many men to be something that is forced on them by virtue of their positions rather than the quality which they should bring to the job. The replies regarding "buck passing" were by no means consistent. The foremen claim that the management makes them "pass the buck" instead of accepting responsibility by the policy of having other departments take over many of the duties formerly belonging to the foreman. Some appear to think it as necessary to know what not to do themselves as what to do.

Leadership is stressed by their text-book, and yet this is among the qualities given few votes. Here again it was found that many of the foremen did not look on themselves as leaders. They consider it sufficient if they maintain discipline and their men do what they are told to do. It is not easy to make them see that their salaries are dependent on the profits of the shop and that the profits of the shop come from leadership as much as from improved machinery and scientific management.

Submerging the Foremen in Red Tape

Some men feel that they are so submerged in red tape and rules that all they can do is to get their breath without attempting to do more than is put before them in the form of direct orders. The shops these men come from appear to be making money. How much more they could make if the foremen rose to their opportunities for leadership is a question not yet answered.

Judgment and Loyalty as Qualifications of Foremen

Judgment is another item in the same class as leadership. Like the latter quality, the men say that the need for judgment has been taken away from them. To be sure they admit that there are times when the machinery of management becomes clogged and they are obliged to revert to their own ingenuity and judgment in order to straighten things out.

Another low-rater is loyalty. Only 76 mentioned this quality, 39 placed it with the first seven, and three rated it first. Most employers place this close to the top of the list. As corporations grow in size, the separation between the real management and the foremen becomes so great that the latter lose their sense of personal loyalty. A few companies are able to maintain a shop or company spirit that must be worth thousands of dollars more than it costs, but their example is seldom noticed or followed. It is very difficult to be loyal or have any other feeling of sentiment for a shop unless there is some one man or a small group of men who are visible with some frequency, to whom loyalty may be directed.

Knowledge of Men is not as Much Appreciated as it Should be

Another qualification which is always highly valued by employers, but which had rather scant attention from the foremen, is knowledge of men. It appears from the discussions that the foremen feel that, having tamed their crew to the point where orders are obeyed without open objection, they have done enough. The natural result is that workmen soon learn that all that is necessary to hold a job is to follow directions literally.

Noon-day discussions and street-car talk would enlighten many a works manager if he could hear them without being seen. There are dividends concealed but ready to appear in any shop that encourages its foremen to learn to know their men and to get on such terms of friendship and comradeship that the men will feel free to make constructive suggestions. To be sure, there is some reason for smothering suggestions, because so many are not constructive, but there seems to be no way of getting the men who have good suggestions to submit them without letting the meddlers have a chance to say something too.

Opinions obtained from several hundred foremen indicate that, in general, they do not look upon themselves as leaders, but consider it sufficient if they maintain discipline and see that the men working for them do what they are told to do. It is important for a foreman to realize that the economic success of the shop in which he works depends largely upon the leadership of the men in charge of the different departments, for such leadership is just as important a factor in increasing production and improving quality as modern machinery and efficient planning of the work.

Health as an Important Factor

The younger men think that good health is natural and permanent. Self-control comes next, naturally enough, because it is quite likely to be tied up with bodily and mental health. Energy is also more or less connected with health, though by the time a man has been a foreman for a few years he is likely to find that mental alertness overshadows bodily energy. With the thousands of magazine articles advocating pep and energy, it is surprising that more foremen did not echo them.

The planning of work is a function that foremen claim has been so largely taken away from them that they did not think it worth rating; but even with production departments, there seems to be enough planning work left to the foremen to justify more attention than it now receives.

How are Resourcefulness and Tact Rated?

Resourcefulness received all the attention that might be expected when we consider how many of the shops represented are working in a steady routine and how little call for resourcefulness there is. The few men who are doing what might be called engineering work or work for engineering projects as distinct from manufacturing, all put this quality high in their lists.

Tact gets little attention. Two men placed it first, probably because it is not a common thing to find around a shop. The fact that most of these men work to very definite standards of measure-

ment seems to affect their process of thinking. They know that 9.76 inches is not about 10 inches but 9.76 inches, and from that they come to the conclusion that an order is an order, and why palaver over it?

Probably all those who mentioned tact, and there were 117 of them, have it themselves or are about to acquire it. Probably they have had some bumps through lack of it. It is an attribute that might be encouraged both up and down the line. There seems to be an idea that tact works only one way, and that it is desirable only from a subordinate toward a superior. We are becoming democratised rapidly, however, and in the course of a few years I expect to see tact rated as an important asset.

What Does Cooperation Mean?

Perhaps the one rating that is the furthest from the place employers would give it is that of cooperation. The shops these men come from preach cooperation morning, noon, and night; yet only half the foremen mentioned it, one-sixth put it in the first seven, and only one man put it at the top of his list. Discussion brought out this point: The foremen do not know what the management means by cooperation, and there is no definite and visible reward for it.

The general feeling among foremen is that cooperation means that they should refuse to accept work from a preceding department unless it is right, and that they should make sure their own work is right before they pass it along. In almost every shop, cooperation seems, in the minds of these men, to mean personal inspection of the product of the department.

Foremen do not always see that sometimes it is better to push forward one order so that men in the next department may have work to do, even though that order may not be the next in succession, nor do they see that there may be times when one foreman might save the company money by doing a little more than his assigned part of a job, thereby expediting the whole order. They seem never to have had such things brought to their attention. It appears that the definite kind of cooperation which the management expects has never been described to the foremen. In a few shops there are exceptions, but the rule seems to be as stated.

Then there is the matter of rewards for cooperation. The men are rewarded for most of the things they do for the benefit of the company, and in many cases so directly that the foreman knows what he is being paid for. In the case of cooperation, however, there is a pretty definite feeling that the management neither knows whom to reward nor what reward to make.

Importance of Study and Need for Technical Books

The desire to study gets a large vote, though not so large as might be expected. The men questioned concentrate their desire to study on technical knowledge. They complain that there is too little to study. Outside the machinists, carpenters, patternmakers, steam engineers, and a few kindred trades their contention is pitifully correct. It is safe to say that three-fourths of the trades commonly practiced in this country have no worthwhile literature. The machinery trades are a shining exception.

Most managers will say that they know and are glad to teach everything that their workmen ought to know about their trades. The majority of managers would rather have green men who do not have to be "untaught" anything than to have men who have picked up a smattering of a trade. Those managers who think deeply on the subject of education say that their foremen generally lack knowledge of the rest of the organization and that they need to know something of the principles of doing business.

It is very seldom, indeed, that a manager points out a foreman to me as lacking in knowledge of his particular trade, but there is a very evident tendency for foremen to stop studying their own job in their own shop. Many men, and not the older ones by any means, seem to feel that once having been taught to do a certain thing in a certain way, they should give improvement of that method no thought. Instead of approaching what they do themselves with a large interrogation mark, they feel that it would be wrong to think about it.

It is of the greatest importance that the duties and responsibilities of a foreman be made clear so that he will not look upon himself as a mere routine man. Foremen in large shops have seen one function after another taken away from them. They have seen production and planning boards organized and employment offices installed, and they wonder what there is left for them to do. In many shops, the management has done little or nothing to make clear to the foreman that by being relieved of certain duties that can be done better by a special department, he is free to devote himself to work that will promote efficient production in his department.

A Sympathetic Personality as an Asset to a Foreman

The lead given by the text-book is not well followed in the case of sympathy. Only a little more than half the men considered it worth mentioning; 39 put it among the first seven. They think that sympathy means sentimental affection, and that is probably the reason they do not follow the author of their text-book. It is not easy to convince them that leadership without sympathy is practically impossible and that men will do more work for a foreman who shows them sympathy when needed.

Of course, it is easy to overdo sympathy and become an "easy boss" and get no work done, but that is not sympathy—it is merely soft headedness. Any workman who has had a serious setback, a fire without insurance, a death in his family, or a serious accident will never forget help of the right sort from the concern he works for, and the initiative in giving such help should come from his foreman.

Qualities at the Top of the List

The remaining items come near the top of the list and their positions will doubtless be agreed on by most employers. They include teaching ability, which is of great value in industries having no supply of skilled help to draw from. We would expect to find reliability, firmness, and fairness

listed by every man, and yet there were many who omitted it. Fairness was remembered by the largest number; 222 out of the 248 listed it, and 19 put it at the head of the list.

The remaining item is technical knowledge, which received 66 votes for first place, far outdistancing all other qualifications, but running behind fairness for mention.

As has already been indicated, discussion bears out the fact that these men dislike to give up the workman idea. To coin an expression which I have not heard before, they have a "workingman complex." That they are part of the management—and a necessary part—seems to come to their minds very slowly. Even when the managerial part of their job is held before them, it is not likely that a large proportion of them grasp the full meaning of it. Here, again, they confuse a title with a function. They think of a manager as a general manager, a sales manager, a works manager—in other words, as the head of an organization. But each man, in his own place, must manage the work and men entrusted to him.

How Can a Shop Profit by Better Foremanship?

In summarizing the factors which prevent a great many shops from obtaining all their legitimate profits from manufacture, the following seems true: Foremen do not study their fellow men as carefully nor as intelligently as they should. Their study needs direction, but first they must be convinced that they do not know as much as they think they do. Once they learn more about their fellow men they will surely become more sympathetic in the right sense. They will understand how to cooperate and how to secure cooperation.

The next step is improved leadership. It is a hopeless and thankless task for individual men to go through this training, because all these things must be done in relation to other men. That is, the old saying that it takes two to make a fight, is just as true when made to read, "It takes two to cooperate."

Two qualities which may be improved are resourcefulness and personality. Both improve with practice. A man who always plans at least two ways to escape from a dilemma is likely to become resourceful without thinking about it. Personality comes about through right thinking. So many of us in these days cannot bear to be alone with our thoughts, that it may seem like bitter medicine to advise a young man to go and think by himself.

The sturdiest of our ancestors in the pioneer days spent days and weeks moving rocks and stumps to make a place for a little garden, and the very strongest personalities come from the descendents of those lonely ancestors of ours. Every time I see a stone wall in New England I marvel at the patience and perserverance of the man that built it and I wonder how much of a philosopher he may have been.

The natural reaction when Mr. Brown reads this article is for him to say, "That's just what ails Black's shop, but my foremen are different." The foremen referred to in this article—248 of them—are only a drop in the bucket compared with the whole number of foremen in the country, but they come from so many industries and so many varieties of shops, and their replies agree so thoroughly, that I am convinced that further study will only confirm the views so far advanced.

Many foremen say that the need for judgment has been taken away from them. It is only when something goes wrong with the systems and plans made in other departments and the machinery of production becomes clogged that they are asked to exercise their own ingenuity and judgment in order to straighten things out. It is unfortunate that larger scale production and modern management seems unable to take advantage of the full ability of the individual, and it is likely that the science of management in the future will develop some modification of present methods so that a larger proportion of the ingenuity, judgment, ideas and experience of the foreman may be made available for the greater success of the business.

* * *

EXTRUSION OF BISMUTH WIRE

Bismuth wire is used in the construction of thermopiles, where a combination of bismuth and silver is considered advantageous. Since bismuth cannot be drawn into wire by ordinary methods, some rather unusual processes have been employed to obtain bismuth wire. A bulletin of the Bureau of Standards some years ago described a process in which molten bismuth was poured from a certain height on a smooth glass plate. The resulting thin sheet was rolled still thinner and cut into strips.

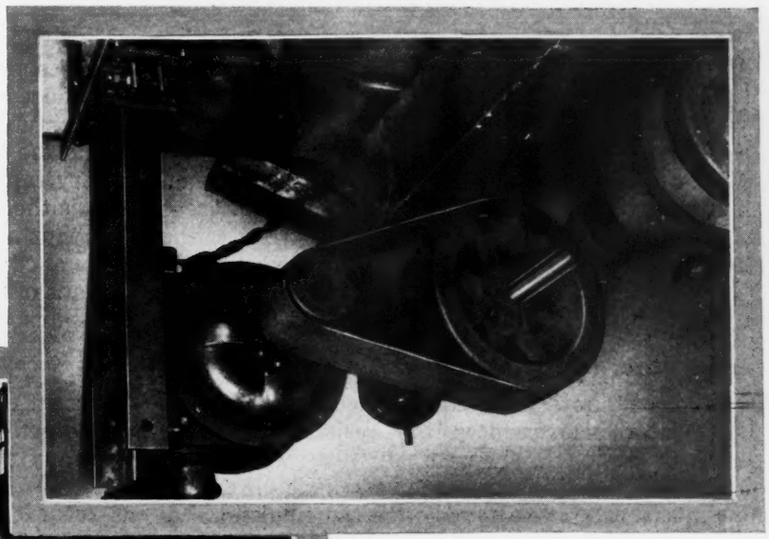
Recently a method has been developed for making circular bismuth wire by forcing the metal through an orifice 0.004 inch in diameter. The bismuth is introduced into the press either in powdered form or in the form of a slug, the metal being heated to about 210 degrees F. Even at room temperature the wire can be forced through the orifice, but in that case, a higher pressure is necessary than if the wire is extruded at the higher temperature mentioned. The bismuth wire is said to be so pliable that it can be wound up on a spool as fast as it is formed. It can be wound around a 1/8-inch rod and straightened out again without breaking, if care is exercised. It possesses a fair tensile strength.

* * *

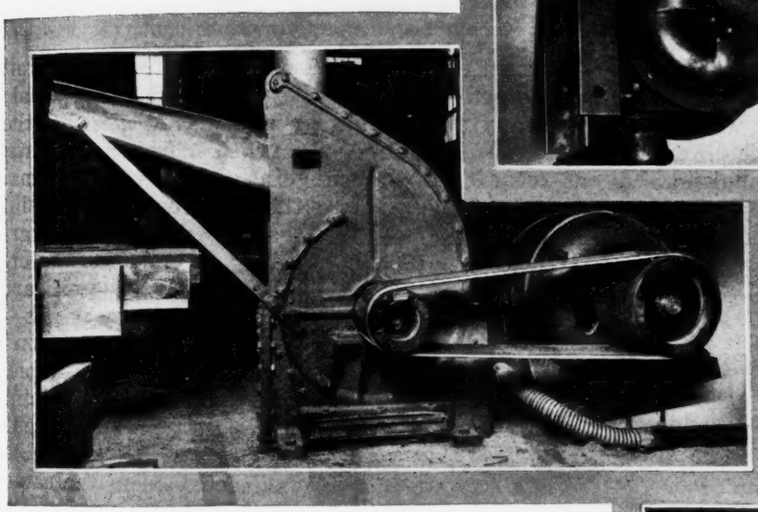
Fog, one of the greatest hazards to aviation, may lose some of its dangers in the near future as the result of the development of a new type of quartz neon gas-filled lamp by the research engineers of the General Electric Co. This lamp, which resembles a ball of reddish orange fire when in use, emits practically all its visible radiation in the long wave lengths which tests have shown to have greater fog penetrating power than light higher in the spectrum. It was found that during a heavy morning mist, when the laboratory building in which the new lamp was housed could not be seen 500 feet away, the brilliant red glow penetrated to a distance of half a mile. A neon lamp of earlier type, with but half the candlepower, was reported to have been seen by an aviator on a clear night at a distance of seventy-five miles.

Possibilities of Short-center Belt Drives

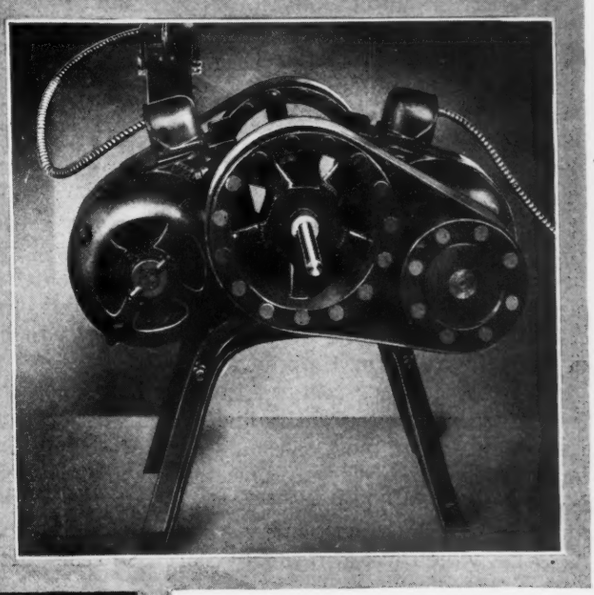
Photographs by Courtesy of the Rockwood Mfg. Co., Indianapolis, Ind.



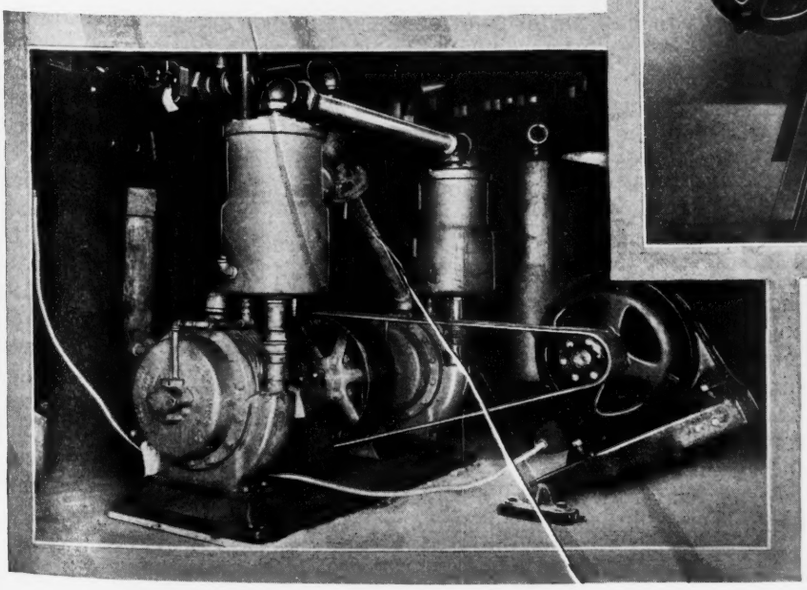
Short-center Drive in which the Motor is so Suspended that Gravity Maintains a Predetermined Tension on the Belt. The Motor is of 7 1/2 Horsepower Capacity and Runs at 1250 Revolutions per Minute



(Left) Another Method of Applying Weight of Motor to Insure Uniform Tension and Speed of Belt. The Belt Speed in this Installation is 6000 Feet per Minute and the Motor has a Rating of 40 Horsepower



(Right) Machine with Two Belt Drives in which the Driving and Driven Pulleys are so Close Together that a Lead Pencil can Barely be Passed between Them. The Motors are of 5 Horsepower Capacity and Run at 1800 Revolutions per Minute



Short-center Drives are Equally Suitable for Slow or Fast Speeds. The Motor in this Illustration Runs at only 900 Revolutions per Minute. It has a Rating of 7 1/2 Horsepower

Lubricants for Tapping

By A. L. VALENTINE, Manager, Tap and Gage Division, S K F Industries, Gothenburg, Sweden

PROPER lubrication while tapping is of the utmost importance to the cutting qualities and length of life of a tap. Experiments have proved that the power required in tapping—that is, the resistance to the action of the tap when threading a nut—varies considerably with different lubricants. The following lubricants reduce the resistance to the cut when threading forged nuts, as well as those made from hexagon drawn material; the threads in the nut have a good finish and appearance: Stearine oil, lard oil, sperm oil, rape oil, and a mixture of 10 per cent graphite with 90 per cent tallow. A mixture of cutting emulsion with water also reduces the resistance to the threading action fairly well. In tests with emulsion, it was noted that it made very little difference how much water was mixed with the emulsion. A mixture of one part emulsion to 160 parts of water proved practically as good as a mixture of one part emulsion to ten parts of water.

Compound oils, that is, mineral oils mixed with animal or vegetable oils of the type usually employed for cooling lubricants for turning and milling, produce a considerably higher resistance than the animal or vegetable oils and cannot, therefore, be recommended for tapping. Mineral oils not mixed, and ordinary lubricating and machine oils, are wholly unsuitable. The resistance to cutting is very great, the taps break, and the threads in the nuts are badly torn; ordinary water reduces the cutting resistance better than some of the compound oils. Animal and vegetable oils, therefore, ought to be used exclusively for tapping.

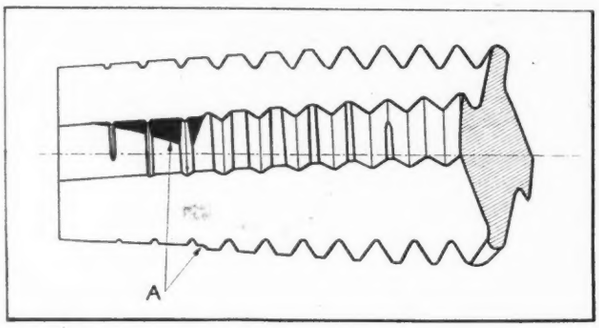


Fig. 1. Part of Tap Worn Cylindrical by Contact with Nut when Tap is Started

The quantity or stream of the lubricant does not seem to have any great influence on the cutting resistance, but in most cases a strong stream in the length direction of the tap directed toward the hole is recommended, because it washes away the chips, and the tap is also prevented from heating and expanding, which would result in increased resistance and greater wear.

For tapping aluminum, kerosene has been found to be the best lubricant. For tapping cast iron, a strong solution of emulsion is recommended; oil has a tendency to make cast-iron chips clog in the flutes, thus preventing the lubricant from reaching the cutting teeth of the tap. For tapping copper, milk has been found to be the best lubricant.

When staybolt taps have the thread cut away in alternate lands and have so-called "interrupted" threads, the tap is not so likely to tear the threads and the lubricant is able to reach the cutting teeth more easily. Staybolt taps are generally used at high speeds—from 150 to 250 revolutions or more per minute—and therefore a stream of lubricant cannot be used on them in the same way as in ordinary tapping, because the high speed of the tap causes the oil to be thrown out from the tap. Staybolt taps are usually dipped in some kind of oil of such a consistency that it tends to stick to the threads of the tap. Linseed oil is recommended for this purpose.

Most Recent Experiments on Lubricants for Tapping

Recent experiments conducted at the S K F plant at Gothenburg, Sweden, on a much larger scale than any made at an earlier date indicate that the generalizations made from the earlier experiments, as recorded in the foregoing, are correct. Animal and vegetable oils are the best for tapping mild steel, and of these stearine oil and "Winter-strained" lard oil are preferable. Mineral oils—machine oil—were found to be wholly unsuitable. Compound oils containing less than 50 per cent of animal or vegetable oil acted much the same as the mineral oils and cannot be recommended for threading. When the compound oils contained over 50 per cent animal or vegetable oil, they could be used and were then found to be almost as good as the pure animal and vegetable oils.

A few emulsions have given almost as good results as animal and vegetable oils, but the kind of emulsion used plays an important part, and the majority of emulsions do not give good results. In almost all the tests made, a large volume of lubricant gave somewhat better results than a small quantity. This was particularly evident in the case of the thinner oils. Kerosene, turpentine, and graphite proved unsuitable for tapping steel.

With regard to the size of the hole tapped when different lubricants were used, it was found that the lubricant that produced the least resistance to tapping generally tended to produce the largest tapped hole. For example, when a hole was tapped dry, it would be a most accurate reproduction of the tap as far as size was concerned, but the threads were not clean and smooth, and, of course, the length of life of the tap was reduced. Water used as a lubricant produced good looking threads, but rather high resistance. Stearine oil, which reduced the resistance to tapping to the greatest extent, also produced the largest diameter in the hole.

Unsuitable lubricants and ineffective methods of forcing them into the flutes during the tapping op-

eration often are the cause of the material being tapped attaching itself or clinging to the threads of the tap. As soon as nut material is found attached to the tap, it must be honed or ground off immediately, because after the material starts to stick to the tap, the amount that adheres increases very rapidly and will soon destroy not only the cutting quality of the tap, but often the tap itself.

Reason Why Chips Cling to Taps

There are various causes for this clinging of the nut material to the thread sides of the tap. The tendency of the material to adhere to the tap is affected by the tapping speed, the relief of the tap, and most of all by the lubricant and the methods of forcing it into the flutes. On ground taps, the tools, such as drills, reamers, and milling cutters, are generally ground or sharpened immediately when they appear dull. When tap users realize that a tap should be treated like any other cutting tool in this respect and that it must be sharpened as soon as it becomes dull, the number of broken taps will be greatly reduced.

In tapping machines, the fact that the tap is dull is usually apparent when it begins to slip in the holder or chuck. The tap should then be taken out and sharpened instead of increasing the friction between the tap shank and the holder, as is often done, in order to obtain the necessary extra power to drive the dull tap.

A tap wears partly on the outside surface of the chamfered portion and partly on the front faces of

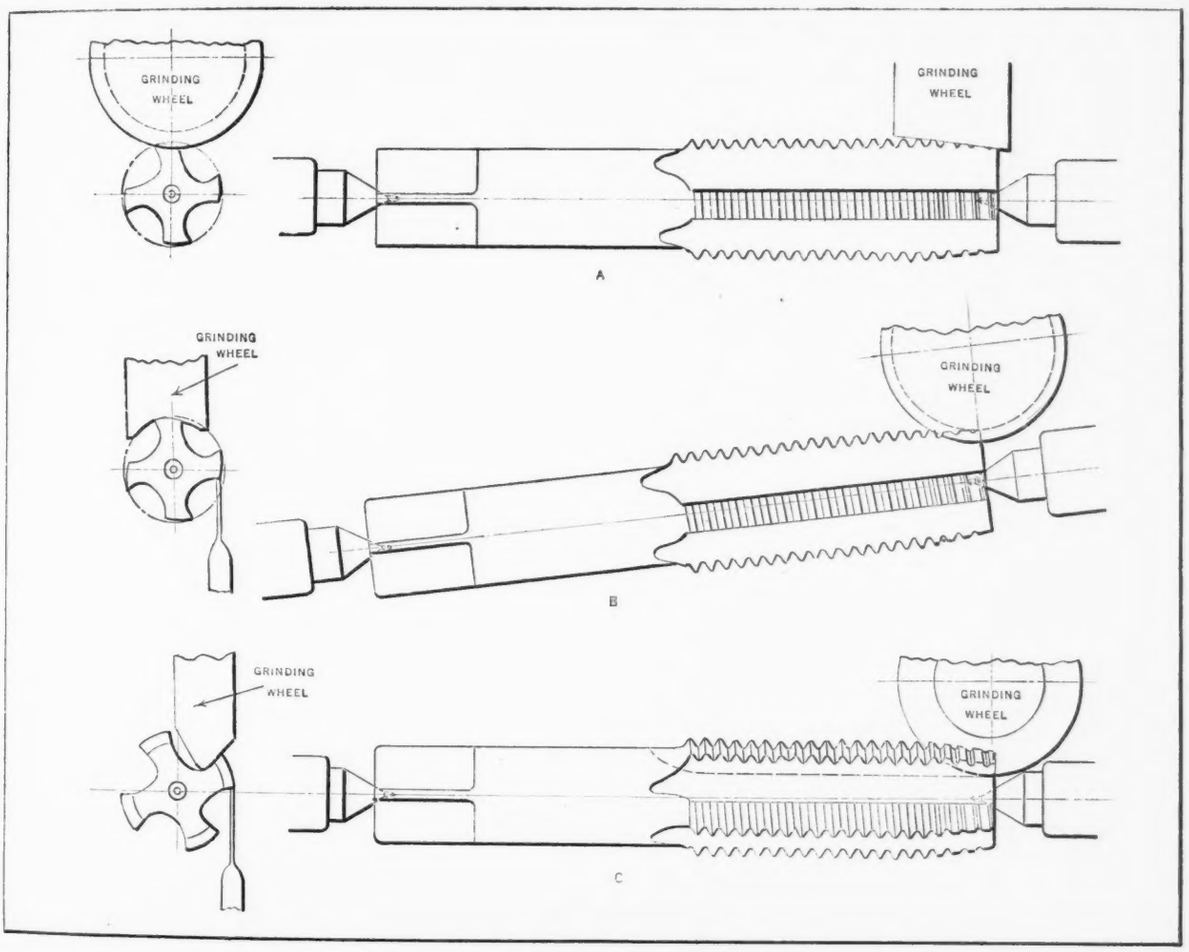


Fig. 2. Different Methods of Sharpening Taps

extremely thin, soft surface on the thread profile caused by the grinding may also be partly to blame. This extremely thin, soft surface may be impossible to detect by ordinary means, but it is, nevertheless, always present, as on all other ground surfaces not afterward lapped. European nut materials cause greater trouble in clinging to the taps than American steels, because the former seem to have a tougher structure.

Sharpening Taps

Effective lubrication with suitable oil retards the dulling of taps, but can never wholly prevent it. The sharpening of taps is frequently neglected and they are permitted to become dull without any attention being given to them. All other cutting the cutting edges. The wear on the outside is principally concentrated on that place on the lands where the tap first comes in contact with the nut in tapping. At that place near the point of the tap, as indicated at *A* in Fig. 1, will be found a cylindrical worn surface. After this cylindrical surface has once been formed, it increases very rapidly. The wear on the front face of the lands is at first principally concentrated on the tops of the threads on the chamfered portion, but through continued use of the tap it extends toward the bottom of the thread, as well as to the threads on the straight-threaded portion.

At *A* in Fig. 2 is shown the principle employed in grinding the chamfered part of the tap and its relief when a machine with a relieving attachment

is available. At *B* is shown the method used for grinding the chamfered part and its relief when an ordinary cutter grinding machine only is available. At *C* is shown the method used for grinding the front faces of the tap lands.

The sharpening should be done, as shown at *A* in Fig. 2, by first grinding the outside of the chamfered portion until the worn surface shown in Fig. 1 has disappeared. This grinding also produces the required relief. If a machine with an eccentric grinding relieving attachment is not available for this purpose, the operation can be performed by an ordinary cutter grinder.

The original relief on the tap should be used as a guide when sharpening or grinding the new chamfer. After some experience, the operator will be able to do this grinding or sharpening quite rapidly. The rounded off tops of the threads will also mostly disappear in the grinding operation shown at *A* or *B*, but the front face of the lands is sharpened as shown at *C*, Fig. 2, in order to remove any rounded off or worn portions still remaining on the threads.

Both of these sharpening operations must be done with great care, so that the chamfer is made exactly the same length on the different lands of the tap and concentric with it. The cutting angle, as well as the flute form, must, of course, also be maintained.

A worn tap naturally works with much greater resistance than one with sharp cutting edges. If, therefore, one wishes to prolong the length of life of the tap to the greatest possible extent, it is necessary to sharpen it in time, and under no circumstances should the rounded off corners be permitted to become greater than the chip thickness. If this happens, the tap cannot cut, but will wedge itself in the nut and break.

* * *

ALUMINUM IN RAILWAY CARS

Eight passenger cars have recently been built by the Pennsylvania Railroad in which all the metal above the floor line is either aluminum or an aluminum alloy. With this construction, a saving of over 13,000 pounds has been made in each car. The Illinois Central Railroad has built over two hundred cars in which all roof sheets, a large part of the paneling, and many of the doors are aluminum. These cars have been in satisfactory operation over a period of two years. The Chicago-Joliet Electric Railway has built an interurban car in which considerable quantities of aluminum have been used both in the main structure of the car and for various fittings, such as seat pedestals, stanchions, and trolley poles. The body of this car weighs only 10,500 pounds, or 474 pounds per passenger, while the corresponding steel car weighs 22,000 pounds, or 900 pounds per passenger.

A Simple Die-casting Machine

In March MACHINERY, H. L. Thompson will describe the design and operation of a rapid-acting, single-cavity die-casting machine suitable for casting a comparatively small number of parts, such as trial parts. Die-casting has generally been considered a highly specialized art and one that could be profitably used only by experts in their line. This belief has doubtless shunted many good die-casting propositions into other channels, as the initial outlay for experimental die-cast parts has appeared prohibitive. This article describes a machine by which die-castings can be made one at a time with a comparatively small and simple machine. The design of the machine is described in detail, and its use may provide an unexpected impetus to the application of die-cast parts.

RESPONSIBILITIES OF MODERN INDUSTRY

The following statements from an address by Gerard Swope, president of the General Electric Co., are quoted as arranged by *Commerce and Finance*. The responsibilities of modern business are, according to Mr. Swope:

1. *To the public*: The test of the efficiency of any organization is measured not only by its service and the quality of its products, but by its continual and progressive reduction in the prices of its products.

2. *To employes:* a. Nothing can take the place of adequate earnings for the working man. It isn't conditions of work, it isn't hours of work, it must be first and foremost adequate earnings. The only way to safeguard adequate earnings is to put power in back of the working man.

b. We have to remove some of the worries that have attended working men from time immemorial—first, the uncertainty of life. It is necessary to educate them and then to provide an easy means of insuring their lives.

c. To put a man in the position, and educate him to the responsibilities and opportunities of becoming his own home owner.

d. To offer a means of thrift and investment where the principal is assured and the income is fair and uniform and certain.

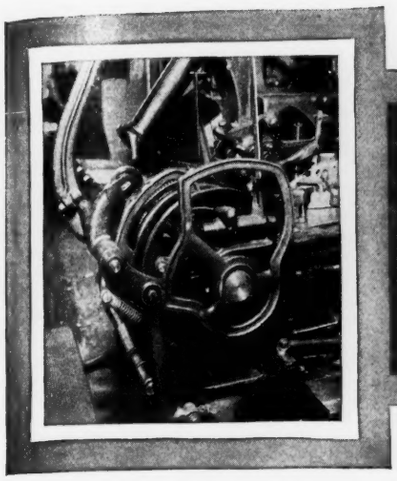
e. To try to solve the problem of unemployment.

3. *To shareholders:* What shareholders want is a fair, regular, and uniform return, and what management wants is such a return to shareholders that when they need new capital, for the extension of their business or new tools of production, it will be forthcoming. Of course, incident to that, if you are going to expect the confidence of your shareholders, you must tell them of the activities of the company, and give adequate publicity in regard to earnings, orders, and shipments.

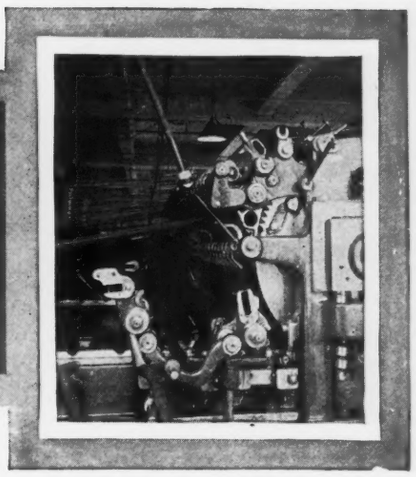
4. *To itself*: Large companies have opportunities and also responsibilities—of research, of seeking for better methods and new truths and new ways of doing things, and, of course, of educational work. Industry has more to fear from the unsuccessful than from the successful, from wrong policies, from ignorance of method, and from ignorance of the elements of cost.

* * *

The safety of air transportation was pointed out in a paper recently read by L. D. Seymour of the National Air Transport at the transportation meeting of the Society of Automotive Engineers in Chicago. Since May 12, 1926, a period of 1 1/2 years, in day and night operation, seven days a week, airplanes of this company have flown nearly 2,000,000 miles without anyone having been injured or any cargoes lost.



Ingenious Mechanical Movements



THE "BEAVER-TAIL" STOP

By E. V. CRANE, Staff Engineer, E. W. Bliss Co.

The "beaver-tail" stop mechanism is used to prevent or minimize inertia shock or impact at some point in a repeated cycle where a clutch is thrown or tools are brought into contact with each other or with the work. The name "beaver-tail" is applied to this mechanism because of the shape of the cam which forms an important part of it. Fig. 1 shows a "beaver-tail" stop applied to a small power press. The driving pinion *A* revolves continuously, and drives gear *B* through ordinary gear teeth except when the "beaver-tail" mechanism comes into action, at which time the motion of gear *B* is controlled by the two rollers *D* and the "beaver-tail" cam *C*. If driven gear *B* is to be stopped once during each revolution, only one cam *C* is attached to it. In this particular case, however, two stops per revolution are required, so that two cams are used. The teeth of the driven gear are cut away at each stopping position, as shown at *E*, and the large developed tooth or cam *C* takes their place.

The rollers *D* on the driving pinion are diametrically opposite each other, and their centers are on the pitch circle of the pinion. When the beginning of the blank space on gear *B* reaches the pinion and during the next quarter revolution of the pinion, one roller *D* moves along the "beaver-tail" cam and brings the gear to rest with a harmonic motion. The center of the roller at the point of engagement coincides with the point of tangency of the two pitch circles, so that engagement takes place without shock. The driven gear is locked during the brief dwell which occurs while the rollers are revolving about a concentric part of the cam. This stationary or neutral position is shown in the illustration and also by the diagram Fig. 4. After the dwell, the other roller, during a quarter revolution of the pinion, engages the cam and accelerates the gear until it has the same speed as the pinion, when the gear teeth mesh and the ordinary gear drive is resumed.

There may be one, two, or more stops per revolution, depending upon requirements and the number of stopping positions provided. Both stopping and starting are accomplished with harmonic deceleration and acceleration, so that there is no shock to the mechanism (except from possible backlash) due to the reversal of strains. While the deceleration is taking place, the driven member acts temporarily as the driver, returning energy to

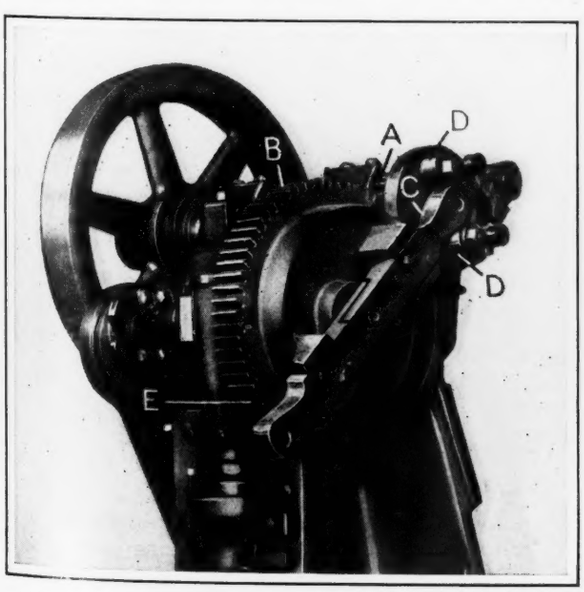


Fig. 1. "Beaver-tail" Stop for Disengaging and Engaging Clutch while Press is under Full Load

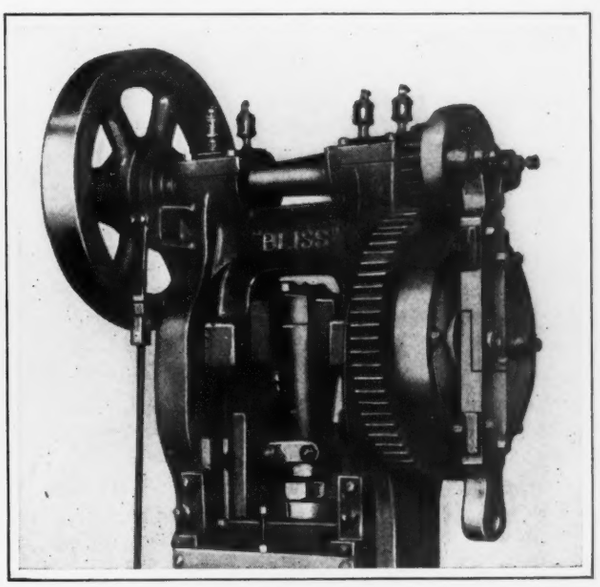


Fig. 2. "Beaver-tail" Stop to Eliminate Tool Shock Arranged for Adjustment to Suit the Tools

the drive as the revolving parts are brought to rest. During a brief dwell period of twenty or thirty degrees of driver rotation, while the cam is in the neutral position, a clutch on the driving shaft may be thrown in or out without inertia or load effect from the driven parts. As the load picks up, the driver has temporarily a greater mechanical advantage, due to the position of the roll on the cam, than it normally would have because of the ratio of the gears.

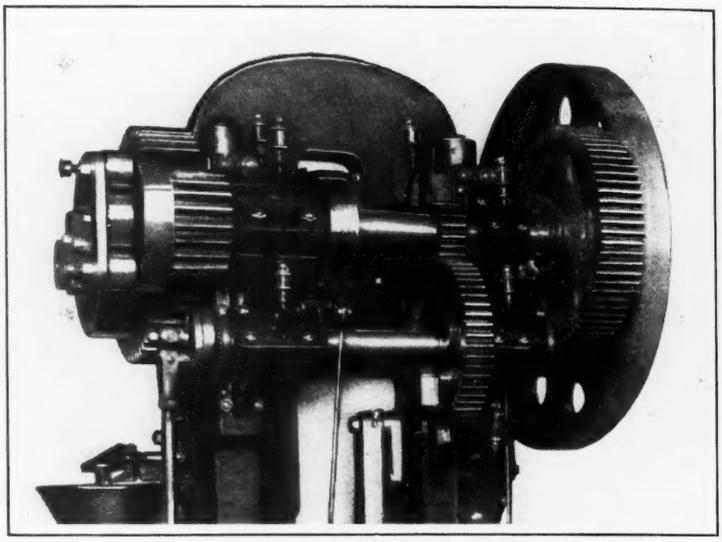


Fig. 3. Rear View of a Collapsible Tube Extrusion Press having "Beaver-tail" Stop

Application to Power Presses

The "beaver-tail" stop is an invention of Charles R. Gabriel. It was developed about twenty-five years ago for use in connection with the feed mechanism of gear-cutting machines built by the Brown & Sharpe Mfg. Co. During the last five or six years this stop mechanism has been utilized very successfully by the E. W. Bliss Co. in conjunction with the drives of power presses designed for special purposes. Although the mechanism proper has been described previously, the purpose of this article is to explain certain important principles governing the design and application of this stop mechanism to power presses.

Fig. 1 shows a small press used for curing celluloid, arranged with a double "beaver-tail" stop to permit disengaging and engaging the clutch at the bottom of the stroke while the press is under full load. This stop mechanism has also been used on larger machines having shafts up to 5- or 6-inch sizes. Machines equipped with this stop are used either for curing celluloid or for other products which must be held under pressure for a period of time. The rolling key clutch is used on the back-shaft or driving shaft, and since the clutch is disengaged and engaged as the rollers are passing across the dwell or neutral position on the cam, it is protected from an otherwise unduly severe strain. Presses are sometimes built for this service without using the "beaver-tail" cam, but if the load is appreciable in such cases, the life of the clutch is likely to be very short.

A rather different use of the motion is its application for removing the impact load from the tools. Thus the press shown in Fig. 3 is one of a series used for the extrusion of collapsible tin tubes. The "beaver-tail" is so placed that it brings the slide and punch to rest just as contact is made with the slug or blank to be extruded. The extrusion then takes place with an easy accelerated motion, the whole action resulting in various manufacturing advantages and an enormously greater tool life.

With the clutch on the back-shaft, as shown, the driven gear must be fitted with two "beaver-tails,"

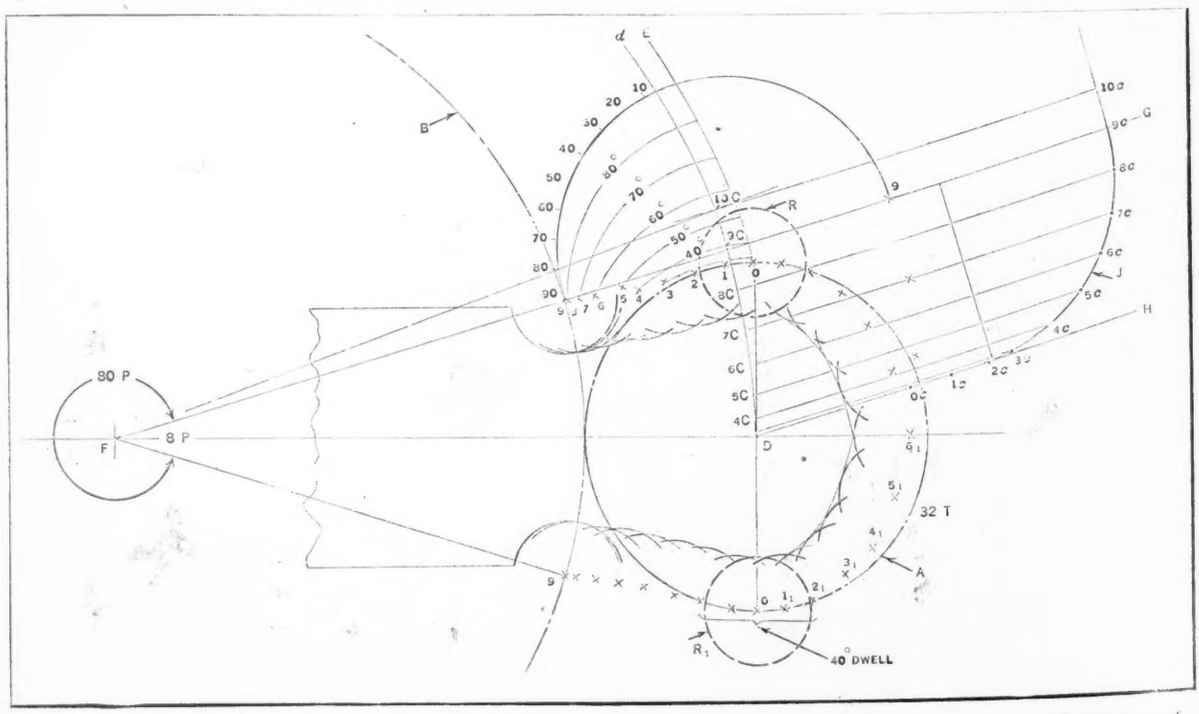


Fig. 4. Development of a "Beaver-tail" Cam for a 3 to 1 Gear Ratio and a Dwell Equal to About 40 Degrees of Pinion Rotation

one at the point of contact of the tools, and the other opposite it, to favor the clutch in stopping the press. A variation of this practice is to place the clutch in the gear on the main shaft and use only one cam at the tool contact position. This cam need not have any allowance for dwell. The one developed in Fig. 5 is without dwell.

The press shown in Fig. 2 fitted with an experimental blanking die has another feature worth noting. It is arranged with a clamping ring connecting the driven gear to the shaft so that the relative position of the gear and the crankpin may be changed readily to suit any tool height; hence, the stop may be located to act just as the punch comes into contact with the work.

Size of Driven Gear

The pitch circle velocity and travel of the gear and pinion are the same except during the slowing down and picking up periods, when the pinion moves half its circumference and the gear moves a much shorter distance. This difference in travel reduces the number of teeth or pitches on the gear (including those teeth that are actually cut away) and hence also reduces the gear diameter.

In the example shown in Fig. 5 with a ratio of four revolutions of the pinion to one of the gear, using a pinion having 32 teeth, there would normally be 128 gear teeth ($4 \times 32 = 128$). But in the case selected the gear moves only the space of ten teeth during the slowing down and picking up periods, while the pinion moves a half revolution or sixteen teeth. Accordingly, the difference ($16 - 10 = 6$) must be deducted, leaving 122 teeth or pitches as the gear circumference. Its pitch diameter relative to the pinion is in the ratio of 122:32.

Profile of "Beaver-tail" Cam

The construction or development of this motion is worked out in Fig. 4. The method is based upon keeping the gear stationary and revolving the pinion about it as in planetary gearing, determining the relative progress of the center of the pinion (along the arc *Dd*) and then plotting the corresponding positions of the rolls which thus outline the proper shape of the cam.

The pitch circles of the pinion and gear are indicated at *A* and *B*. The rollers *R* and R_1 are shown in the neutral or locking position 0–0 which is their position when the center of the pinion coincides with the center line of the cam at *D*. This is one of the limiting positions. The other is either of the points 9, when the two rolls and the center of the pinion are on a radial line from the center of the gear. Here one roll center coincides with the point of tangency between the pitch circles of the gear and pinion, and the driving action shifts from the rolls to the gear teeth (or vice versa).

The spacing of points 0–0 depends upon the pinion, which we have assumed in this case to have 32 teeth (the number must be even) and, say, a 4-inch pitch diameter. The pinion moves through just half a revolution from the point where one roll engages the cam to the point where the other roll leaves it on the other side, the movement being

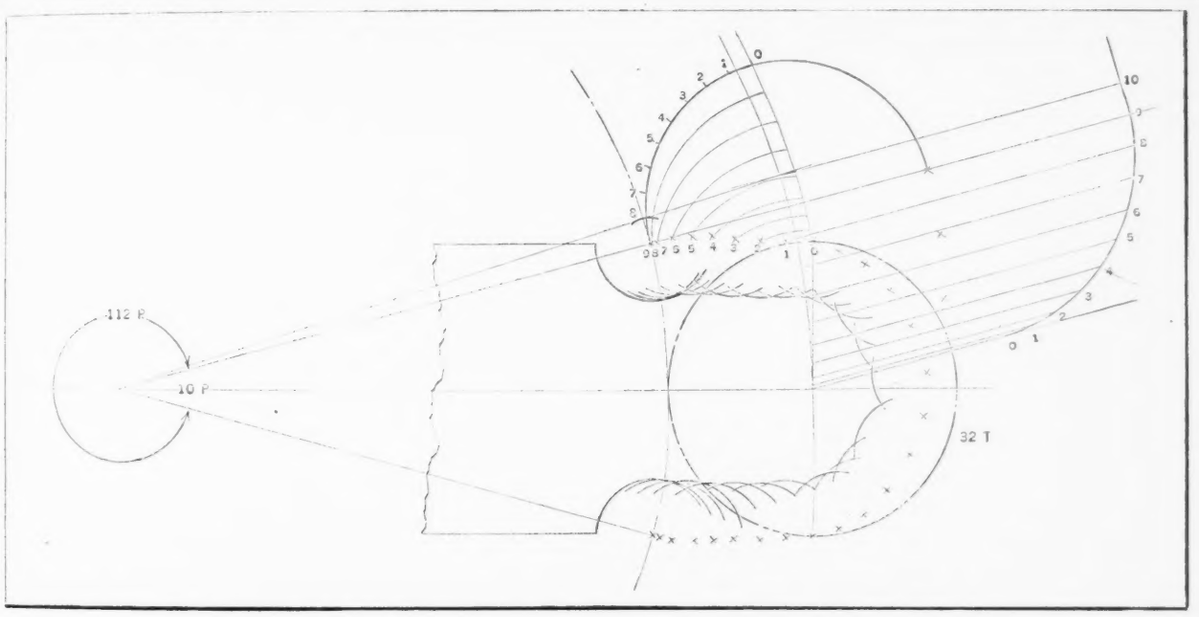


Fig. 5. Development of a "Beaver-tail" Cam for a 4 to 1 Gear Ratio and No Dwell

equivalent to 16 teeth. The gear obviously moves a shorter distance, which we have assumed in this case to be 8 pitches. (A greater distance reduces the dwell but eases the accelerating or decelerating action.) This is 8 pitches less than the pinion movement. Accordingly, the pitch circumference or number of teeth of the gear for a 3:1 ratio is $32 \times 3 = 96 - 8 = 88$. The gear diameter equals $(4 \times 88) \div 32 = 11$ inches.

The order of construction, after determining the pitch diameters of the gear and pinion is as follows: Lay off the center line *FD*, the pinion pitch circle *A* about the center *D*, and the gear pitch circle *B* tangential to it, about the center *F*. Locate the roll centers 0–0 in their neutral position on the intersections of the pinion pitch circle and the vertical center line through *D*.

Locate the starting and finishing positions of the roll centers 9–9 on the pitch circle *B* of the gear—in this case, 8 pitches apart or 4 pitches each side of the center line *FD*. Draw the radial line *FG* from the center of the gear through one of the points 9. The centers of the pinion and both rolls

must lie on this line when the roll R is at 9. Draw the arc Dd and the arc $0E$ from the center F and the points D and 0.

Following the scheme of revolving the pinion about the gear to develop the shape of the cam, the center of the pinion for various positions of the roll R must move along the arc Dd. When the rolls are at the locking or stop position 0–0, the pinion center is at D. When the roll R is at the point 9, the pinion center is at $9C$, the intersection of the arc Dd and the line FG. Here the gearing is in normal mesh and the gear and pinion are moving relatively at full speed. Since the pinion moves through a quarter revolution (90 degrees) in accomplishing this change of speed, we have taken nine positions for the roll, representing a change of 10 degrees each on the pitch circle of the pinion. The corresponding positions of the center of the pinion must be on the arc Dd between $9C$ and D, and should be spaced to give harmonic deceleration. To get a starting point for this harmonic change, lay off from 9 on the gear circle B a distance equal to 10 degrees on the pinion pitch circle. (Note the small arc at the division marked 80). A radial line from the gear center F through this point, intercepts the arc Dd at the point $10C$. Then the distance $10C$-$9C$ represents the travel of the center of the pinion for 10 degrees of rotation (direct-geared, full speed).

To locate the pinion center positions below $9C$ for harmonic deceleration, the following approximate construction has been used: Draw the line DH from D parallel to FG. Swing the arc J from a center on FG, tangent to DH. From the point $9c$ at the intersection of the arc J and the line FG, lay off the distance $10c$–$9c$ about the arc J, continuing along the line DH. Transfer the points $8c$, $7c$, etc., on arc J, by means of lines parallel to FG, to the arc Dd. This gives the pinion center positions $8C$, $7C$, etc. Since the points $0c$, $1c$, and $2c$ all fall on the point D, there is a relative dwell in the motion during the roll positions 0, 1, and 2.

To locate the roll center positions, swing an arc equal to the pitch radius from the proper center and measure off the corresponding number of degrees from the arc $0E$ as a starting point. Thus the points 1 and 2 are on the radius from the center D, and are 10 and 20 degrees, respectively, from 0. The point 5, for example, is on a pinion radius swung from the center $5C$, and is measured off 50 degrees from the intersection of that radius with the arc $0E$. This gives the positions of the center of the roll R between the points 0 and 9. Corresponding positions of the roll R_1 may be obtained at the same time, as they are at the other extreme of the pinion diameter in each case. Thus the point 5_1 is at the intersection of the diameter line through the points 5 and $5C$ and the pinion circle arc swung from the center $5C$. The remaining positions may be obtained by repeating the construction on the other side of the center line FD, or since the cam is symmetrical, by transferring the points 0 to 9 and 0 to 6_1 across the center line FD on perpendicular lines to the corresponding points on the other side of it. The diameter of the rolls R and R_1 is determined to suit the case, and the profile of the cam is outlined, as shown, by drawing in a portion of the roll circumference, swung from each of the roll center positions.

Note in Fig. 4 that the dwell is about 40 degrees; that is, in laying out the uniform distance $10c$–$9c$ around the arc $9c$–D, the points $2c$, $1c$ and $0c$ all fall on the neutral center D, so that rotation of the pinion through the corresponding positions does not result in any motion relative to the cam. If it is desired to reduce this dwell, the number of pitch spaces between the points 9–9, assumed in this case as eight pitches, should be increased. For convenience in gear-cutting, this distance should always be a whole number of pitches.

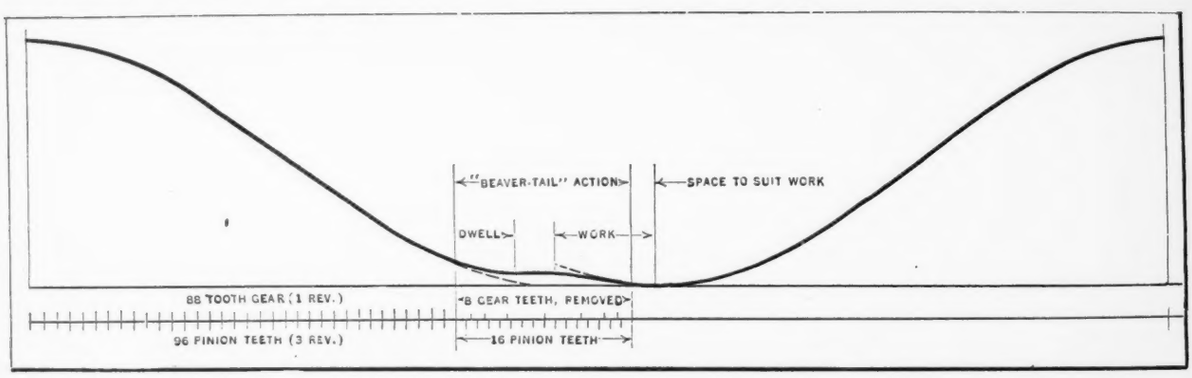


Fig. 6. Modified Crank Motion of an Extrusion Press Using the "Beaver-tail" Shown in Fig. 4

"Beaver-tail" Cam without Dwell

Fig. 5 is arranged to show one of the possible variations in construction to obtain other effects. This cam is designed to eliminate dwell. It is assumed that the gear moves through ten pitches instead of eight in the period of time that the pinion moves through sixteen. In this case, the gear ratio is taken at 4 to 1, although it is well to note that lower gear ratios are preferable where speed and inertia forces are high.

The action resulting from the use of the "beaver-tail" cam in the drive of a crank press and the modification of the crank motion is shown by the curve in Fig. 6. This is based upon the design shown in Fig. 4. The motion of the pinion, which has uniform speed, is used as the time basis for the curve. The spacing of the crank is either fixed or adjustable to suit the work, which in this case may be assumed to be extrusion. Note that a close approximation to uniform motion during the working period results from the combination of harmonic acceleration of the "beaver-tail" and harmonic deceleration of the crank.

MACHINERY'S DATA SHEETS 123 and 124

PLAIN TAPER STOCK KEYS

American Standard for Square and Flat Types

Diameters of Shafts (Inclusive)	Square Type			Flat Type			Tolerances on Keys		Stock Length of Key L†	Diameters of Shafts (Inclusive)	Stock Length of Key L†												
	Maximum Width W	Height at Large End* H		Maximum Width W	Height at Large End* H		Width (Minus)	Height (Plus)															
1/2–9/16	1/8	1/8		1/8	3/32		0.0020	0.0020	1/2	1/2–9/16	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/2	3	3 1/2	4	4 1/2	5	6
5/8–7/8	3/16	3/16		3/16	1/8		0.0020	0.0020	3/4	5/8–7/8	1 1/8	1 1/2	1 7/8	2 1/4	2 5/8	3	3 3/8	3 3/4	4 1/8	4 1/2	4 7/8	5 1/4	6
15/16–1 1/4	1/4	1/4		1/4	3/16		0.0020	0.0020	1 1/2	15/16–1 3/4	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	8
1 5/16–1 3/4	3/8	3/8		3/8	1/4		0.0025	0.0020	2	1 13/16–2 1/4	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8
1 13/16–2 1/4	1/2	3/8		1/2	3/8		0.0025	0.0025	2 1/2	2 5/16–2 3/4	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	9
2 5/16–2 3/4	5/8	1/2		5/8	7/16		0.0025	0.0025	3	2 7/8–3 1/4	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9
2 7/8–3 1/4	3/4	5/8		3/4	1/2		0.0030	0.0030	3 1/2	3 3/8–3 3/4	3 1/2	4	4 1/2	5	5 1/4	6	6 1/2	7	7 1/2	8	8 1/2	9	10
3 3/8–3 3/4	7/8	3/4		7/8	5/8		0.0030	0.0030	4	3 7/8–4 1/2	4	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11
3 7/8–4 1/2	1	7/8		1	3/4		0.0030	0.0030	4 1/2	4 3/4–5 1/2	5	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	10 1/2	11	12
4 3/4–5 1/2	1 1/4	1		1 1/4	7/8		0.0030	0.0030	5	5 3/4–6	6	7	7 1/2	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12	13
5 3/4–6	1 1/2	1 1/4		1 1/2	1		0.0030	0.0030	6														

All dimensions in inches.
*This height of the key is measured at the distance *W* from the large end.
†The minimum stock length of keys is equal to four times the key width, and the maximum stock length of keys is equal to sixteen times the key width. The increments of increase of length are equal to twice the width.
Developed under the procedure of the American Engineering Standards Committee.

MACHINERY'S Data Sheet No. 123, New Series, February, 1928

GIB-HEAD TAPER STOCK KEYS

American Standard

Type of Key	Shaft Diameters (Inclusive)	Key		Gib Head		Tolerances	
		W	F*	C	D	Width (Minus)	Height (Plus)
Square Type	1/2–9/16	1/8	1/8	1/4	7/32	0.0020	0.0020
	5/8–7/8	3/16	3/16	5/16	9/32	0.0020	0.0020
	15/16–1 1/4	1/4	1/4	7/16	11/32	0.0020	0.0020
	1 5/16–1 3/4	3/8	3/8	11/16	15/32	0.0020	0.0020
	1 13/16–2 1/4	1/2	1/2	7/8	19/32	0.0025	0.0025
	2 5/16–2 3/4	5/8	5/8	1 1/16	23/32	0.0025	0.0025
	2 7/8–3 1/4	3/4	3/4	1 1/4	7/8	0.0025	0.0025
	3 3/8–3 3/4	7/8	7/8	1 1/2	1	0.0030	0.0030
	3 7/8–4 1/2	1	1	1 3/4	1 3/16	0.0030	0.0030
	4 3/4–5 1/2	1 1/4	1 1/4	2	1 7/16	0.0030	0.0030
	5 3/4–6	1 1/2	1 1/2	2 1/2	1 3/4	0.0030	0.0030
Flat Type	1/2–9/16	1/8	3/32	3/16	1/8	0.0020	0.0020
	5/8–7/8	3/16	1/8	1/4	3/16	0.0020	0.0020
	15/16–1 1/4	1/4	3/16	3/8	1/4	0.0020	0.0020
	1 5/16–1 3/4	3/8	1/4	5/8	5/16	0.0020	0.0020
	1 13/16–2 1/4	1/2	3/8	7/8	3/8	0.0025	0.0025
	2 5/16–2 3/4	5/8	1/2	1 1/8	1/2	0.0025	0.0025
	2 7/8–3 1/4	3/4	5/8	1 3/8	5/8	0.0030	0.0030
	3 3/8–3 3/4	7/8	3/4	1 5/8	3/4	0.0030	0.0030
	3 7/8–4 1/2	1	7/8	1 7/8	7/8	0.0030	0.0030
	4 3/4–5 1/2	1 1/4	1	2 1/4	1	0.0030	0.0030
	5 3/4–6	1 1/2	1 1/4	2 3/4	1 1/4	0.0030	0.0030

*This height of the key is measured at the distance *W* from the gib head.

Diameters of Shafts	Stock Length of Key L*																						
1/2–9/16	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	9	10	11	12
5/8–7/8	3/4	1 1/8	1 1/2	1 7/8	2 1/4	2 5/8	3	3 3/4	4 1/2	5 1/4	6	6 3/4	7 1/2	8 1/4	9	9 3/4	10 1/2	11 1/4	12	13 1/2	15	16 1/2	18
15/16–1 1/4	1	1 1/2	2	2 1/2	3	3 1/2	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24
1 5/16–1 3/4	1 1/2	2 1/4	3	3 3/4	4 1/2	5 1/4	6	7 1/2	9	10 1/2	12	13 1/2	15	16 1/2	18	19 1/2	21	22 1/2	24	27	30	33	36
1 13/16–2 1/4	2	3	4	5	6	7	8	10	12	14	16	18	20	22	24	26	28	30	32	36	40	44	48
2 5/16–2 3/4	2 1/2	3 3/4	5	6 1/4	7 1/2	8 3/4	10	12 1/2	15	17 1/2	20	22 1/2	25	27 1/2	30	32 1/2	35	37 1/2	40	45	50	55	60
2 7/8–3 1/4	3	4 1/2	6	7 1/2	9	10 1/2	12	15	18	21	24	27	30	33	36	39	42	45	48	54	60	66	72
3 3/8–3 3/4	3 1/2	5 1/4	7	8 3/4	10	12 1/4	14	17 1/2	21	24 1/2	28	31 1/2	35	38 1/2	42	45 1/2	49	52 1/2	56	63	70	77	84
3 7/8–4 1/2	4	6	8	10	12	14	16	20	24	28	32	36	40	44	48	52	56	60	64	72	80	88	96
4 3/4–5 1/2	5	7 1/2	10	12 1/2	15	17 1/2	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100	110	120
5 3/4–6	6	9	12	15	18	21	24	30	36	42	48	54	60	66	72	78	84	90	96	108	120	132	144

*The minimum stock length of keys is equal to four times the key width, and the maximum stock length of keys is equal to sixteen times the key width. The increments of increase of length are equal to twice the width.

MACHINERY'S Data Sheet No. 124, New Series, February, 1928

Notes and Comment on Engineering Topics

According to a recent report to the Department of Commerce by Vice-Consul Walter T. Costello, of Sydney, Australia, there were 21,242 factories engaged in all lines of manufacture in Australia in 1926.

It is estimated that the 20,000,000 passenger automobiles in the United States represent a total investment of over $16,000,000,000. Their present value, after making an allowance for depreciation, represents about 2 per cent of the national wealth.

More than sixty million miles of wire are now in use to connect the eighteen million telephones in the United States. Of this wire, approximately 67 per cent is in underground cables; 24.5 per cent, in aerial cables; and only 8.4 per cent, in open construction.

Frequent applications of a good lubricant are necessary on wire ropes carrying loads, if the ropes are to be preserved in a good and safe condition. A compound which, when cold, has a thick semiplastic consistency, should be applied hot. In its heated state it is thin and fluid and will penetrate to the inner core. When cool, it will constitute a plastic filler which acts in the double capacity of a lubricant and a rust preventive.

A World Motor Transport Congress will meet in Rome, Italy, in September, 1928, according to an announcement made by the National Automobile Chamber of Commerce, 366 Madison Ave., New York City. A personal invitation from Mussolini has been transmitted to the Chamber through George F. Bauer, manager of the Chamber's foreign department. The International Association of Automobile Manufacturers has accepted the invitation.

Figures recently issued by the Canadian Government Information Bureau at Ottawa indicate that Canada supplies 90 per cent of the output of nickel; 85 per cent of the asbestos; 55 per cent of the cobalt; approximately 9 per cent each of gold, silver, and lead; 6 1/2 per cent of the zinc; and 4 per cent of the copper used in the world. A vast area of mineral-bearing territory, probably the largest and most promising unexplored territory to be found in any continent, still remains untouched and is ready to give up its mineral wealth.

Safe brake performance in an automobile requires that the foot-brake should stop the vehicle from a speed of twenty miles an hour within a distance of fifty feet when the vehicle is traveling on a dry, hard, level road, free from loose materials. The hand-brake should stop the vehicle under the same conditions within a distance of seventy-five feet. These specifications are contained in the *"Safety Code for Brakes and Brake Testing,"* sponsored by the American Automobile Association and the Bureau of Standards.

Seven transformers, said to be the largest in the world, which are capable of furnishing sufficient electrical power to light, heat, and transport a city of half a million people, have just been completed at the Sharon Works of the Westinghouse Electric & Mfg. Co. These transformers are for use near Philadelphia in connection with the new Conowingo Dam project of the Philadelphia Electric Co. Each transformer stands over 31 feet in height, weighs over 200 tons, and has a voltage of 220,000 volts. Each year $12,000,000 worth of electricity will pass through the seven transformers. The seven transformers require twenty carloads of oil for cooling and insulation.

Aluminum paint is opaque to sunlight and possesses high heat and light reflecting qualities. The high light reflectivity makes the paint particularly satisfactory for painting dark buildings, rooms, mills, etc. High reflectivity also means low absorption; therefore, when a tank or other chamber should be kept cool inside, this is facilitated by painting the outside with aluminum paint. It is the reason that an increasing number of gas and oil storage tanks and oil-tank cars are being painted with aluminum paint. In investigations conducted on oil storage tanks in the southwest, by the United States Bureau of Standards, it was found that the temperature of oil in tanks coated with aluminum paint was several degrees lower than in tanks coated with other paints. Furthermore, due to the lower temperature, there is a much smaller loss of the highly volatile oils from tanks coated with aluminum paint.

According to the United States Geological Survey, 11,700,000 horsepower is developed in the United States from water power in plants of 100 horsepower or more. In all Europe, 13,100,000 horsepower is developed from water power. During the six-year period from 1921 to 1926, inclusive, the capacity of water power plants in the United States increased 3,800,000 horsepower. In Europe, the increase during the same period was 4,200,000 horsepower. During the last three years, the rate of increase in the United States has accelerated, whereas in Europe the rate of increase shows a decline. The leading countries in Europe in the use of water power and the horsepower capacity of plants in 1926 were as follows: Italy, 2,300,000; France, 2,000,000; Norway, 1,900,000; Switzerland, 1,850,000; and Sweden, 1,350,000. Japan has water power plants aggregating 1,750,000 horsepower, and Brazil, 500,000 horsepower. At the end of 1926, the plants in Canada developed 4,550,000 horsepower—nearly double the horsepower in 1920.

Current Editorial Comment

in the Machine-building and Kindred Industries

THE PAINTING OF MACHINE TOOLS

The general superintendent of a well-known automobile factory recently called our attention to the desirability of a standardized color for machine tools. At present the machines in his plant vary in color, the majority being black; but many are gray, blue-gray and dark green. Not only is there a difference in the colors, which do not present a harmonious appearance when the machines are installed in the shop, but the quality of the paint varies, some of the paints withstanding the effects of oils, while others do not. It was suggested by this shop executive that machine tool builders could more easily standardize the color and quality of paint on machine tools than many of the constructional features now under consideration. There must be one *best* color, and shop executives generally favor a blue-gray, which is easy on the eyes and tends to brighten up the shop.

One machine tool builder has experimented with the "Duco" finish, and as this has proved satisfactory on automobiles, it may be the best to use for machine tools. Machine and cutting oils, as well as light oils like kerosene, do not affect a "Duco" finish, and it is simple to apply.

* * *

THE TOOL ENGINEER'S JOB

Many tool engineers consider it their duty to design all the tools, jigs, fixtures, and gages that are used in the shop. If the tool engineer is a capable and experienced designer, the tools are likely to be very satisfactory, but also very expensive.

In many instances the services of the tool engineer would be more valuable if he kept thoroughly informed about the best equipment manufactured for the machines used in his plant, instead of trying to design the auxiliary equipment himself. Frequently he could buy tools, gages and other accessories cheaper from manufacturers who specialize in producing them than they could be made in his own plant. Further, the long and specialized experience of the various manufacturers becomes available in solving his problems.

In many large plants, the management is taking this broader view of the tool engineer's job. He is required to find and supply to the production departments the best tools available for the work to be done; but he is not necessarily expected to design these tools himself, nor is he considered less valuable to his firm because he buys from tool manufacturers such equipment as can be obtained from them both better and cheaper than if made in the firm's own tool-room.

DESTRUCTIVE TESTS TELL LITTLE

Some engineers conduct tests of tools or machine parts by overloading them and noting the results; force or pressure being applied until breakage takes place. One engineer made the statement that in this way he obtained quick results and saved time in making tests. The results obtained from testing to destruction do not, however, truly indicate the capacity of the tool for performing its intended service.

The ideal test for every appliance is to subject it to actual service conditions. Tools should run at their ordinary cutting speed; bearings should be loaded with their rated loads; and machine parts, in general, should be subjected to the wear and stresses of ordinary service. If the results obtained from such tests are noted, accurate conclusions may be reached.

There are, of course, instances when it is not possible to make the tests under actual service conditions, because too much time might be required to obtain accurate conclusions; but even then only a reasonable additional duty should be placed upon the device being tested, so as to determine what would happen under an occasional, but reasonable, overload.

* * *

THE TRAINING OF SHOP FOREMEN

We have schools for the training of engineers and well defined apprentice courses for the training of skilled mechanics; but few industrial plants have a systematic plan for training men to become shop foremen. Industrial leaders are beginning to recognize that it is fully as important to select and train men for positions as foremen as it is to train boys to become skilled mechanics or engineers.

It is believed that young men selected for this kind of training should have worked at least two years in a shop, so as to become thoroughly familiar with the general methods of shop work. Then they should take an intensive two-year course of instruction, such as is provided by a few of our technical schools. After having finished this course, they should return to the shop for additional experience, and in a few years should be ready for positions of responsibility.

Although no amount of training will make good shop executives of some men, others have a natural talent for organizing and directing work; but even they need more systematic training than has been customary in the past, and it is encouraging to note that means for such training are now being provided by some of the technical educational institutions.

A Better Name for Small Tools

The expression "small tools" is generally used in the metal-working industries and is understood by all mechanics in the machinery industry to mean such tools as taps, dies, reamers, milling cutters, drills, and counterbores; but the expression is not descriptive and it recently has been proposed that tools of this kind be called "metal-cutting tools," and the industry making them, the "metal-cutting tool industry." The latter name appears to be sufficiently descriptive. It has a definite meaning, not only within the machine-building industry, but also outside of that field. The industry engaged in making metal-cutting tools has become so large that it is a misnomer to call it the small tool industry.

The Outlook for Aviation

By CHARLES L. LAWRANCE, President, The Wright Aeronautical Corporation, Paterson, N. J.

TO look ahead it is an almost infallible rule that one must look backward. Looking backward, then, to see the obstacles that have been overcome in aviation, we will gain an insight into the problems that still face the industry.

There have been three distinct phases in the development of the art of flying—pre-war, war, and post-war. During the pre-war stage the few pilots who were bold enough to take to the air were satisfied to be able to fly, regardless of the lack of comfort and the hazards. Flying itself in the days before 1914 seemed complete justification for the effort.

With the advent of the war, the airplane was called upon to perform new and unusual duties. There was a continual demand for more and more speed, greater maneuverability, higher service ceilings, more comfort for the pilot, and sturdy, rugged construction to withstand the strain of war flying. The bamboo poles, laced together with wire and adhesive tape, upon which the pilot perched and to which were attached the rather flimsy wings were soon swept into the limbo of bygone things. Four years of war wrought many changes. The pilot was placed in a cockpit in a covered fuselage. New wing curves were designed, and these new wings embodied greater efficiency and strength. The speed range mounted from 50 to 60 miles an hour, on past 100, and finally up to 130 miles an hour. Special aviation motors were designed and placed in production, huge bombing planes were built, and fast pursuit and observation planes were designed and produced in large numbers.

Charles L. Lawrance, President, Wright Aeronautical Corporation

And then suddenly—the war was over. Hundreds of thousands of dollars had been invested in manufacturing plants and machinery—literally hundreds of war production planes were almost immediately available for commercial flying, and there were also hundreds of war-trained pilots who were eager to continue flying. In 1919, the Government turned the surplus war-built aircraft over to public sales and many of these pilots purchased planes—particularly the "JN" training planes—and used them for commercial service. But, as may now be easily understood, these war-planes were not to be easily converted into aerial messengers of commerce. The ideal commercial airplanes have taken five years to design and build. Even yet, as with practically all types of aircraft, they are still far from the goal of perfection.

During the period immediately following the war, the aircraft manufacturers who could foresee the commercial use for airplanes also saw the immediate competition with war surplus aircraft and war surplus motors, the prices of which were ridiculously low. Within five years most of these planes passed beyond the useful period of life, and there was an increasing demand for a new commercial aircraft carrier. The Wright "Whirlwind" aviation engine, which has become increasingly popular in the commercial field, has been made so by economy and reliability, as well as by the lack of any other suitable war surplus motor of similar horsepower. The only war-developed motors now available, the supply of which is rapidly decreasing, are the OX-5, 90-horsepower water-cooled motor and the Liberty 400-horsepower water-cooled motor.

Present Tendencies in Airplane Design

In consideration of the comfort of the passengers, a very large number of commercial planes are being designed and built as closed-cabin aircraft. Improvements in design and production manufacturing methods make it possible for these planes to be built of welded tube steel construction, which is light and yet sturdy enough to withstand the rigors to which they are subjected.

At present we find a predominance of "Whirlwind"-powered, five-passenger enclosed cabin monoplanes, that are similar to the type used by Colonel Lindbergh in his flight from New York to Paris. It seems strange that the biplane type of enclosed-cabin, five-passenger airplane has been almost entirely supplanted by the monoplane. I do not believe, however, that the monoplane will always predominate in this field, or in the field of the large three-engined passenger transport planes. Biplane construction possesses certain definite advantages over the monoplane type which cannot easily be

overlooked. Among these are the short run necessary for the take-off, and the comparatively small space necessary for landing. At the same time, the biplane does not possess the ideal feature of visibility for the passengers that is characteristic of the monoplane design. There are places where the biplane is more advantageous, and again, there are routes where the monoplane is more suitable.

Well Situated Airports are a Prime Necessity

And now, a word about the light or sport plane. Airplane designers can lay out and build very attractive light planes, but at the present time, we lack a suitable power plant for this type of airplane. It is doubtful, in my mind, whether the light plane will become entirely popular until the airports are brought within closer reach of the general public. From my observations in the development of commercial aviation in the United States, I feel that we need a great deal more development work in the location and establishment of suitable airports. One of the secrets of the popularity of a plane is in bringing it close enough to the centers of population, so that access to and from the field does not consume an unreasonable amount of time. This is, I believe, one of the most serious problems that faces the development of popular aviation. It may be possible to transport mail and express to outlying airports for delivery to cities far away, but where the public is concerned, every effort tending to cut down the trouble involved in getting to and from airports, will hasten the growth of both sport and business flying.

* * *

COSTLY HAND-TO-MOUTH BUYING

The editorial "Costly Hand-to-Mouth Buying" in December MACHINERY has brought forth comment from a number of manufacturers, one of whom writes:

"We hope your editorial will have some influence toward correcting this growing, highly detrimental, business practice. This kind of buying is not only costly to the manufacturer, but costly to the purchaser as well. It means delayed service and additional cost for parcels post and express shipments. Small orders for standard goods should be delivered from local stocks and not through hurry-up orders to the manufacturer."

Another manufacturer writes: "In our plant we have had to provide additional equipment to take care of the insistent demand for quick delivery. As a result, we have a heavy investment in machinery, a great deal of which must stand idle a large part of the time. Though our plant is one of the larger ones in the field, we are in the same position as the small all-around toolmaker who has a shop where he must provide himself with a complete equipment of tools of which he can use but one or two at a time, but must be prepared to produce any kind of work that he may be called upon to deliver.

"It is an expensive proposition from every angle, and it seems to us that a great many have overshot the mark in their efforts to reduce inventories. Instead of economy, they have added an item to their cost which is so intangible and covered up that it is not recognized except through a very careful analysis and comparison of expenses."

SAVINGS THROUGH STANDARDIZATION

Some of the possibilities of saving in manufacturing costs, due to a program of standardization and simplification and the elimination of unnecessary types and sizes, are pointed out in the following statement published by the American Engineering Standards Committee. The results recorded have been obtained in the plant of a large manufacturer.

1. It was possible to reduce 130 stock sizes of steel and brass washers to 64 sizes, making a saving of about $3000 a year in manufacturing costs, and about the same amount in clerical and drafting expenses.

2. In some cases extraordinary reduction in diversity has been possible, as in the case of 1100 pins involving numerous duplications in cable cleats, where several hundred shapes have been reduced to 9; or certain punch fingers where 750 items were reduced to 75, with a saving of $7000 a year. Two items of very large use, involving reductions of 60 per cent and 8 per cent, respectively, each brought about savings of $14,000 a year, and in one of these cases, the standardization was followed by changes in design methods of manufacture, bringing about an additional saving of over $10,000.

3. Standardization of forms used in office work, although a reduction of only about 20 per cent was possible, brought about savings of $7500 a year.

4. On the item of wood screws, a 50 per cent reduction in variety was possible at an annual saving of over $4000, a rather surprising result, considering that the plant in question is engaged in metal-working.

5. Standardization of files, involving an elimination of 85 per cent, saved about $7000 a year.

6. On steel, brass, and copper tubing the savings totaled $7740, reflecting an average reduction of 50 per cent in variety.

7. Brass bars and sheets, on a reduction of 55 per cent in variety, gave an annual saving of nearly $7000.

The savings in this one plant, while small in relation to the total production, were large enough to amount to the total annual business of many thriving industrial plants.

When it is considered that in this plant the cost of setting up a tool for certain small parts was from $3 to $6, it will be seen how rapidly savings accumulate, due to avoidance of unnecessary changes of tools from one style or shape of product to another.

The store-room cost per item of manufacture in this plant, exclusive of insurance, taxes, power and lighting, would average $45 a year, from which arises another evident large saving on the omission of any unnecessary item of production due to unification, although, of course, on account of expenses involved in increased quantities of the standard product, there are costs that offset a part of this possible maximum saving.

* * *

Sheaves and drums for wire ropes for lifting loads should be frequently inspected for wear, as a worn sheave groove can do a great deal of damage to the rope.

Buffing Odd-shaped Parts Automatically

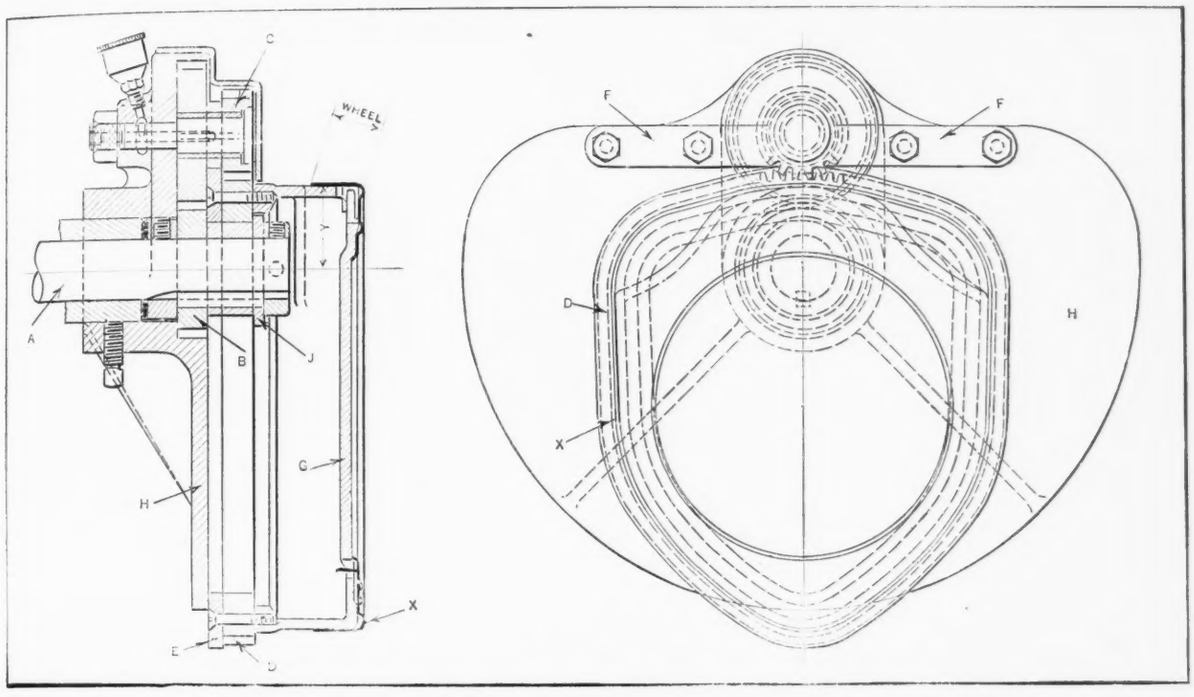


Fig. 1. Mechanism Employed for Buffing an Irregular Lamp Door on an Automatic Buffing Machine

IN buffing or polishing circular parts automatically, it is an easy matter to keep the work in constant contact with the wheel during the operation. This is accomplished by merely rotating the work on its own axis. However, with square, hexagonal, oval, or unsymmetrical parts, the distance from the center of the work to points along the outside varies considerably, and so a special mechanism must be employed on an automatic buffing machine to change the distance between the center of the buffing wheel and the center of the work as the work is revolved. This article will describe

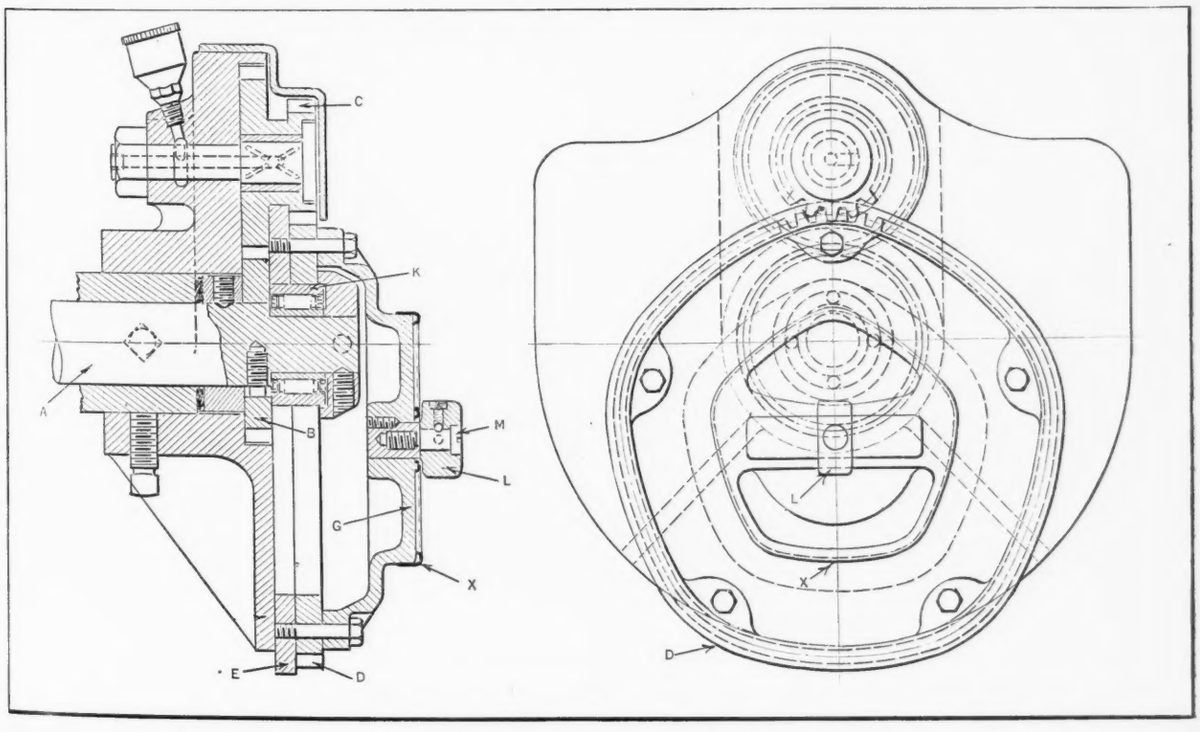


Fig. 2. Equipment Used for Buffing Another Lamp Door for Unsymmetrical Outline

three mechanisms developed by the Automatic Buffing Machine Co., Buffalo, N. Y., for buffing parts of the kind mentioned on the type H machine built by this company.

Buffing Automobile Lamp Doors

Brass automobile head-lamp doors of the outline indicated by *X* in the right-hand view of Fig. 1 are buffed while held by the mechanism shown in this illustration. This mechanism is mounted on spindle *A* of the buffing machine. As spindle *A* revolves, gear *B* which is keyed to the spindle, drives compound gear *C*. The teeth on the forward end of the compound gear mesh with the teeth of rack *D*, which is of exactly the same outline as the work.

Fastened to the rack is a cam *E* which rides between sleeve *J* and a groove in compound gear *C*, thus causing the rack teeth to pass those of gear *C* in the same plane. In other words, there can be no lateral movement of the rack teeth at the point where they mesh with gear *C*, and so the rack is made to revolve eccentrically with the cam, the cam, of course, being also of the same outline as the work. (In practice, each of the mechanisms to be described is set up with the vertical center line of the right-hand views in a horizontal position).

Attached to the front side of the rack is a holder or chuck *G* on which the work is held for the operation, and so the holder and work are also revolved eccentrically with the rack. Dimension *Y*, from the center of machine spindle *A* to the edge of the work where it comes in contact with the buffing wheel, never varies. Casting *H* is of such a design that the operator cannot be caught by the work as it revolves.

For buffing the outside of the door, the work is applied to the buffing wheel as indicated in the sectional view. When this operation has been performed, the face of the door is buffed at the opposite end of the two-wheel buffing machine, while held on a plain chuck. With this equipment, a production of sixty finished doors is maintained per hour, as against fifteen doors per hour when the parts were held manually against a buffing wheel.

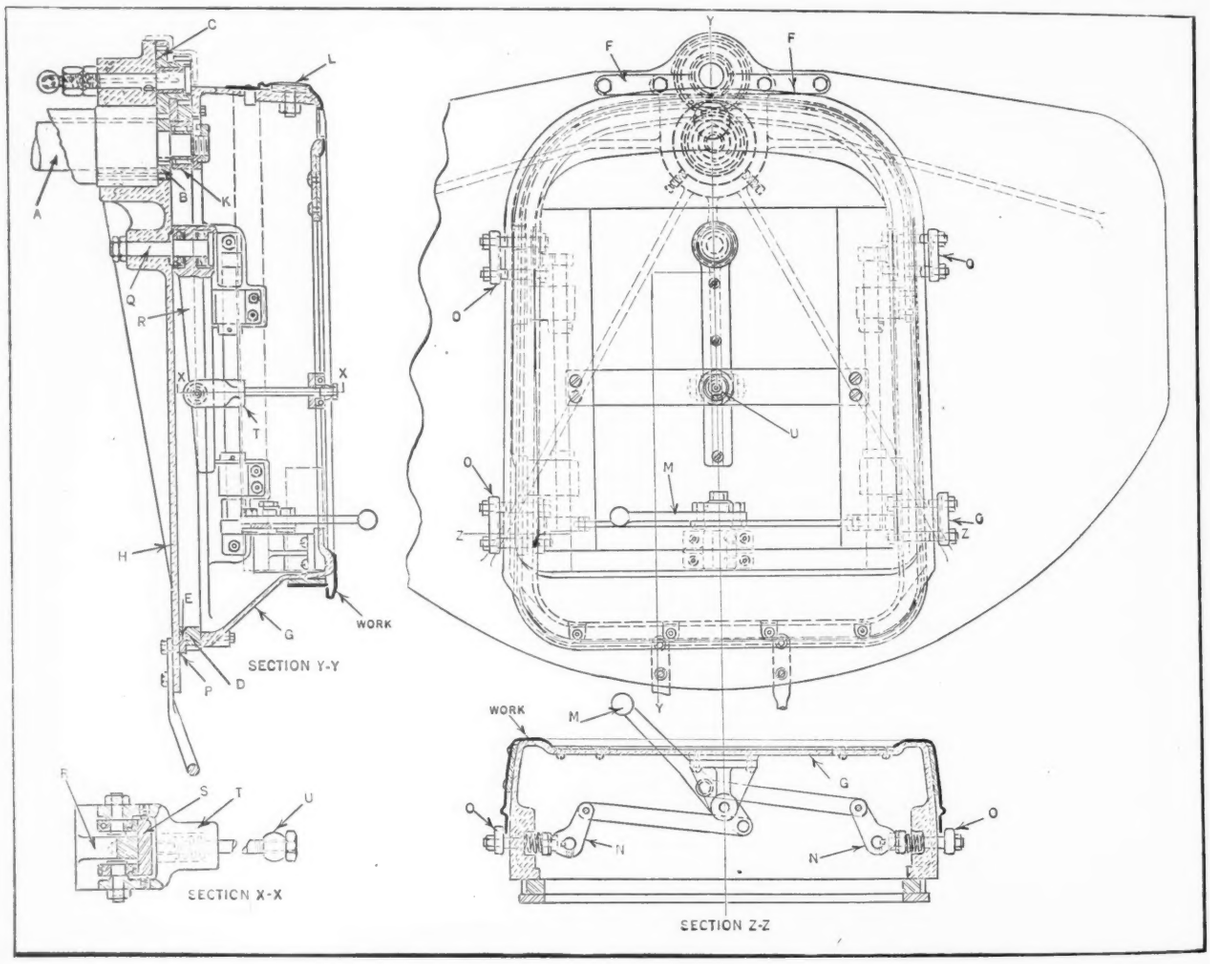


Fig. 3. Chucking Equipment Used in Automatically Buffing Automobile Radiator Shells

Automobile rear-lamp doors pressed from sheet brass to the outline indicated at *X* in the right-hand view of Fig. 2 are rotated past a buffing wheel by means of the mechanism shown in this illustration. In general, this mechanism functions in the same manner as the one previously described, but the part is of a very different shape. The main housing of this mechanism is also mounted on the sleeve of the automatic buffing machine, and power is derived from machine spindle *A*. It is delivered through gear *B* to compound gear *C* and then to rack *D*, which is of the same outline as the work but considerably larger in size. An important point wherein this mechanism differs from that shown in Fig. 1 is that both cam *E* and rack *D* rest on a roller bearing *K*; this construction, of course, considerably reduces friction.

This lamp door is comparatively shallow, and has three openings in the face which make it desirable to hold the part to chuck G by other means than friction alone. Therefore, handle L, which can be conveniently swiveled on stud M, has been provided. With the handle turned 90 degrees from the position illustrated, the work can be slipped over it and on casting G, after which the handle is swiveled into the position shown to lock the part in place by spanning over two ribs of the work. In buffing the outside of this part with the automatic equipment described, a production of 120 doors per hour is averaged, whereas the production with hand buffing methods amounted to only 40 parts per hour.

How Automobile Radiator Shells are Polished and Buffed

Radiator shells for automobiles of different makes are polished and buffed by the use of mechanisms of the general design illustrated in Fig. 3, which shows the mechanism employed in handling Dodge shells. This mechanism is based on the same principles as those already described and, in addition, includes ingenious clamping and holding devices required by the large size of the work.

As in the previous examples, the entire mechanism is mounted on the machine spindle A, and power is transmitted through gears B and C to rack D which is fastened to cam E and form G. A roller bearing K again takes the thrust of the cam and rack. When the work is placed on body G, the filler cap hole is slipped over plug L, so as to protect the edges of the hole while buffing and prevent accumulation of dirt in the hole.

After the radiator shell is placed on the body, handle M is swung to the right to securely clamp the shell in place. This movement of the handle causes four cam-levers N to swivel, which permits extension springs to operate and force four clamps O tightly on the work. When the operation has been completed, handle M is merely swung to the left, as shown, to release the clamps.

Owing to the weight and size of the radiator shell, there would be a tendency for cam E to separate from the face of housing H at point P, unless means were provided to hold it against this face. For this purpose, there is mounted in the housing a shaft Q from which an arm R is suspended. This arm is free to swing in a vertical plane and has a steel plate S fastened to the front, as shown in section X–X.

A yoke T, which is free to run on plate S, is equipped with ball bearings. The yoke is connected by means of a rod to ball U, and the latter is held in a ball bearing mounted in a bar fastened to form G. Hence, as the form revolves, ball U moves eccentrically with it, being permitted to do so because of the free movement of yoke T along arm R and because the arm can swing in the vertical plane as required. There is any amount of freedom of body G and the work, together with cam E and rack D, along the face of housing H, but there can be no variation in the distance from the face of the housing to the work. Guide bars F help to steady the radiator shell while the straight sides are being fed past the buffing wheel.

In polishing and copper-buffing these shells with the equipment described, a production of 10 shells per hour is averaged, whereas the production with hand buffing amounted to only 4 shells per hour.

* * *

Coil Spring Specifications

Even the well informed designer is often at a loss when he meets with the problem of selecting the proper kind of coil spring to perform a certain function. In the article "Coil Spring Specifications," by Rudolph A. Johnson of the Morgan Spring Division of the Wickwire-Spencer Steel Co., Worcester, Mass., which will be published in March MACHINERY, a great deal of information of specific value to designers is given on coil spring specifications. The article has been prepared primarily for the use of engineers and draftsmen, but it can be profitably employed by buyers, generally, to check the completeness and consistency of spring specifications. Incorrect and incomplete specifications are so commonly encountered in the spring manufacturing business and are the cause of so much unnecessary correspondence and loss of time, that a careful study of this article by those engaged in work requiring the application of springs will prove time well spent.

LOAN FUND FOR ENGINEERING STUDENTS

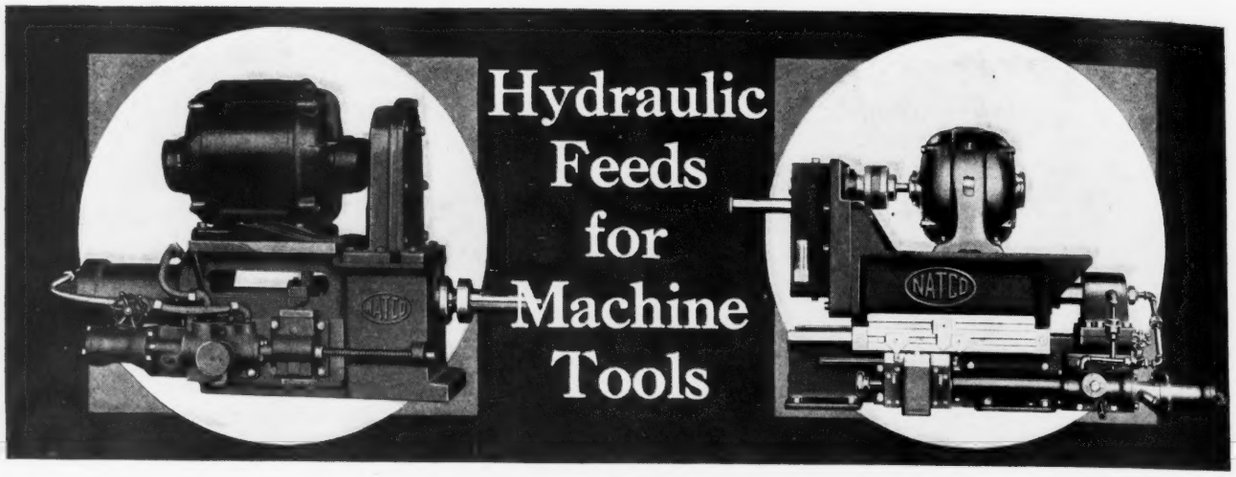
Union College, Schenectady, N. Y., has established a loan fund of $25,000, the gift of Gerard Swope, president of the General Electric Co., from which loans are to be awarded to employes or sons of employes of the General Electric Co. and the International General Electric Co., as well as to other students at Union College, who have attended college for not less than one year. In making this gift, Mr. Swope stipulated that the applicants for loans shall be considered not only from the standpoint of academic attainments and financial needs, but also from the standpoint of character and personal qualifications that will insure that they will derive the greatest good from a continuation of their studies.

A fund of equal amount has been set aside by the directors of the General Electric Co. to be used as a loan fund for the education of employes or sons of employes of the General Electric Co., with no restrictions as to the college that they may wish to attend. It is understood that the student receiving aid will repay the amount loaned when he is in a position to do so, so that the fund can be used continuously as a revolving fund for aiding students.

* * *

TRUCK AND BUS PRODUCTION IN 1927

For the third successive year, the commercial truck production in 1927 exceeded the 450,000 mark, reaching a total of 464,000. Bus registration reached a total of 90,000 in operation January 1, 1928, as compared with 80,000 a year ago. What this total means is best understood by comparing it with statistics of operating units in the electric railway field, when the use of trolley cars was at its height. After twenty years of expansion in the field, there were about 100,000 cars in use throughout the entire United States.



Advantages of Hydraulic Feeds and Drives in Their Application to Machine Tools, and an Outline of the Equipment Employed

WITHIN the last few years many standard machine tools have been designed with hydraulic feed mechanisms built in, as a part of the machine. About the first tools to be so equipped were broaching machines. The production capacity, flexibility of control, and low maintenance cost of these hydraulically operated tools attracted the attention of many machine tool builders and users. Later, grinding machines and drilling machines were successfully equipped with hydraulic feeds.

Following this, several lathe and chucking machine manufacturers and builders of milling machines began the development of hydraulically equipped machines. The recent appearance on the market of a standard milling machine and several grinding machines equipped with hydraulic feeds has further stimulated interest in the application of hydraulic feeds and drives.

Basic Principle of Hydraulic Operation

In practically all new applications of hydraulic transmission to machine tools, no accumulators are employed. Thus, the new system of feeding or driving consists essentially of an oil-pump and a cylinder having a piston driven by oil circulated by the pump and controlled by piping and valve equipment, to give the piston any movement required for feeding or driving. Where hydraulic rotary drives have been applied, a motor similar in construction to the rotary oil circulating or driving pump takes the place of the cylinder and piston arrangement.

Although the basic principle of hydraulic operation of feeds and drives appears simple, the actual development of a practical system involves considerable engineering. The requirements of one machine may be met by comparatively simple equipment, whereas the hydraulic operation of another machine may require an elaborate system of piping, specially designed control valves, and a multiplicity of driving pumps and hydraulically driven devices of various kinds.

Advantages and Possibilities of Hydraulic Operation

The following is a brief resumé of the principal advantages claimed for hydraulic, as compared with mechanical, operation of machine tool feeds and drives:

1. Straight line or rotary transmission of power at any desired point of application.
2. Higher cutting speeds.
3. Longer life of cutting tools.
4. Greater flexibility of speed control.
5. Quick reversal of feed, with practically no shock.
6. Simple and efficient control, both hand and automatic, of all rapid traversing, feeding, and reversing movements.
7. Quiet operation.
8. Low power consumption, which varies automatically to meet resistance offered to cutting tool or driven member.
9. Safety insured by relief valves, which can be set to stop the feeding movement at any predetermined pressure.
10. Ability to "stall" against obstruction, thus protecting parts against breakage and providing an ideal method of cutting shoulders to exact positions and facing to length, by using positive stops.
11. "Slip," which permits movement to slow up when tool is overloaded without "windup" of mechanical feed gear.

How far will the application of hydraulic operation to machine tools go? This is a difficult question to answer, and one which is engaging the attention of many manufacturers at the present time. Information of interest to all machine tool builders and users was presented in a "Symposium on Hydraulic Feeds for Machine Tools" at the annual meeting of the American Society of Mechanical Engineers. The complete symposium, contributed by the Machine Shop Practice Division, consisted of a series of four papers by Walter Ferris, vice-president and chief engineer, Oilgear Co., Milwaukee, Wis.; Waldo J. Guild, chief engineer, Heald Machine Co., Worcester, Mass.; S. Einstein and Hans Ernst, chief engineer and research engineer, respectively, of the Cincinnati Milling Machine Co., Cincinnati, Ohio; and R. M. Galloway, National Automatic Tool Co., Richmond, Ind. The present article is based on an abstract of the paper by Walter Ferris, as well as on important points brought out in the other three papers and in the discussion.

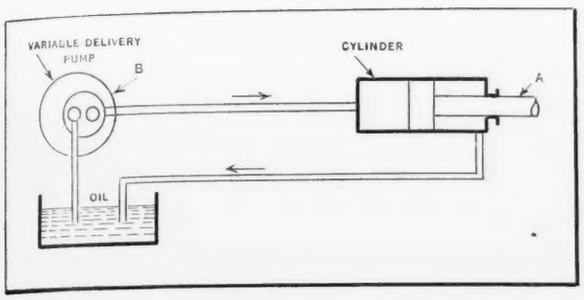


Fig. 1. Hydraulic Feed with Closed Circuit

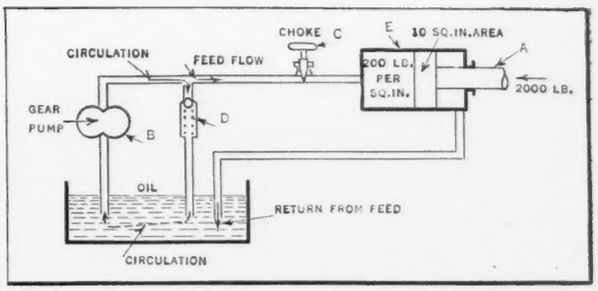


Fig. 2. Hydraulic Feed with By-passed Circuit

12. Fewer moving parts.

13. Provision for checking and comparing action or condition of cutting tools by pressure gage, which indicates cutting force.

14. Adaptability for operating auxiliary devices, such as work-holding clamps, clutches, diamond dressing tool, indexing pins, etc.

15. Comparatively simple centralized control over one or any number of hydraulically operated units arranged or located according to requirements.

16. Greater flexibility of design which permits feed to be adjusted to most efficient rate after machine is assembled.

17. Reliability and low up-keep cost due to comparatively few wearing parts.

Two Fundamental Circuits Employed

The designs of practically all hydraulic feeds and drives recently applied to machine tools have been based on one of the two fundamental hydraulic circuits shown diagrammatically in Figs. 1 and 2, or a combination of these two circuits. In both circuits, the pistons *A*, which impart the required feeding movements, are driven by a liquid delivered from their respective pumps *B*. The pressure is low if the piston encounters no resistance, and the distance it is moved corresponds to the discharge rate of the pump, whether the resistance be high or low.

In the case of the circuit shown in Fig. 1, the rate of feed is changed by varying the volume of liquid delivered by the pump *B*. With the circuit shown in Fig. 2, the feed is controlled by opening or closing the choke valve *C*, causing more or less of the liquid from the constant-volume pump *B* to be by-passed by valve *D*, but admitting liquid to cylinder *E* at the rate necessary to give the required feed.

Pressures Used for Feeds and Drives

Both high- and low-pressure systems are used, depending on the type of machine and its requirements. For instance, the reciprocating tables of light weight internal grinders may be driven by constant-displacement low-pressure gear pumps, as comparatively little pressure is required to move the tables of such machines. On the other hand, a recently built car-wheel boring machine was equipped with four variable-delivery pumps, each having a capacity of 3060 cubic inches per minute at a pressure of 1000 pounds per square inch. Two of these pumps are used for feeding the two boring heads, which have 9-inch feeding cylinders. This equipment gives an available feeding force of 60,000 pounds on each carriage. The other two pumps are used for operating the mechanism for chucking the car wheels.

Variable-delivery Pumps with Closed Hydraulic Circuits

For the sake of simplicity, Fig. 1 shows the pump pushing the piston outward, a valve which must be used to reverse the flow in the discharge and re-

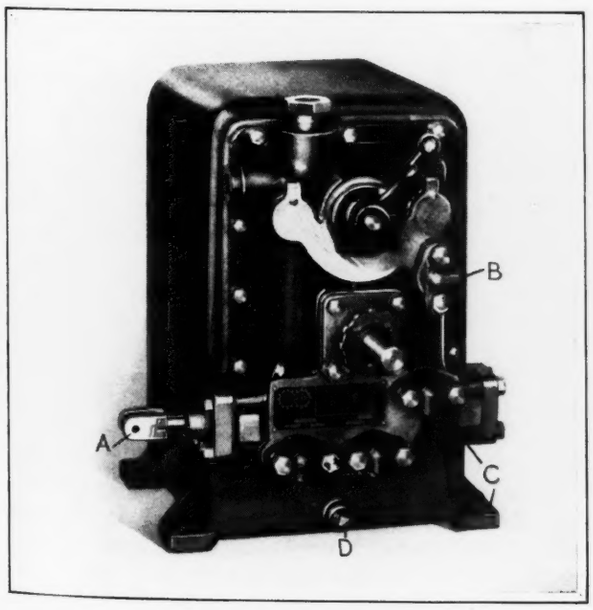


Fig. 3. Automatic Variable-delivery Pump

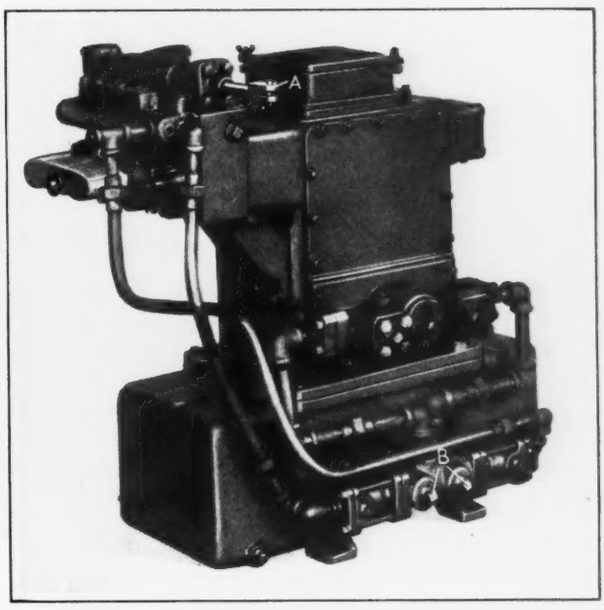


Fig. 4. High-capacity Automatic Variable-delivery Pump

turn pipes on the in stroke being omitted in the diagram. Obviously, the complete arrangement gives a definite rate of feed proportional to the metered discharge of the pump less leakage from the closed pressure side of the circuit through the pump pistons and the feed piston. It will also be clear that the rate at which the piston moves will never exceed the rate corresponding to the fixed discharge of the pump, and that greater or less resistance to the movement of the piston will only raise or lower the pressure in the cylinder and connecting pipe to the pump without materially changing the speed at which the piston moves.

Perhaps the most outstanding advantage claimed for this system of hydraulic transmission of power is the sensitive and easy control of the speed of the driven mechanism. If we pass the entire output of the pumping unit to the driven unit, the speed of the latter may be regulated by varying either the speed or displacement of the pumping unit. This constitutes a very efficient means of control, and one that is limited only by the mechanism involved.

The by-passed circuit illustrated diagrammatically in Fig. 2 shows the gear pump *B* pushing the piston *A* at a rate corresponding to only a fraction of the displacement of the gear pump. The excess displacement escapes through a relief valve *D* into the oil-pot, and is again taken up by the gear-pump suction pipe and continuously circulated.

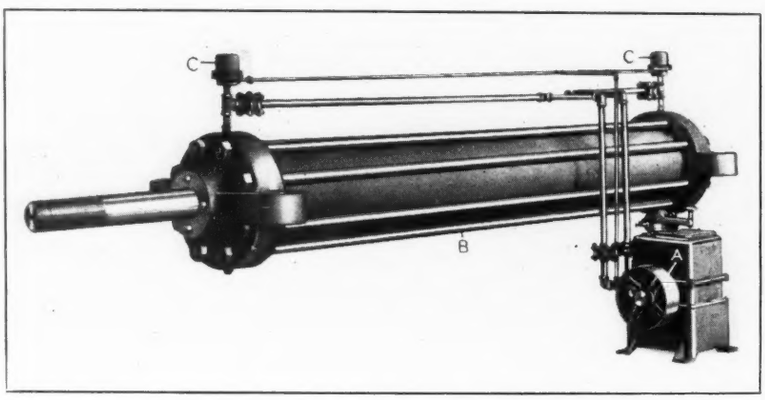


Fig. 5. Hand-controlled Feed Pump and Cylinder

Types of Pumps Used in Feeding Machine Tools

At present there are three types of pumps in general use for feeding machine tools:

1. An accurately made gear pump capable of delivering a constant volume of oil at a constant pressure. These pumps are usually arranged to deliver oil at pressures up to 250 pounds per square inch. A relief valve is used in connection with this type of pump for maintaining an even pressure.

2. A multiple-piston pump with variable stroke. This type of pump is built to deliver a variable amount of oil at pressures up to 1000 pounds per square inch.

3. A pump which combines the first and second types and is arranged to deliver a large volume of oil at about 250 pounds pressure from a gear pump, and a smaller volume at a higher pressure from a variable-delivery piston pump. Both pumps are built into one housing and interlocked as to control.

There is nothing unusual about the gear pumps employed, which are simply required to deliver the necessary volume of oil at a constant pressure. The variable-stroke pumps or units, such as the Oilgear automatic variable-delivery pump shown in Fig. 3, are necessarily more complicated. A variable-delivery pump, with a larger capacity super-charging gear pump, comprises this particular unit. The gear pump, in this case, is not used for rapid traverse, as in the case of the unit shown in Fig. 7.

The pump shown in Fig. 3 was designed recently for use in equipping the smaller sizes of milling, boring, drilling, and similar machines with hydraulic feeds. The following specifications for this pump may be of interest to designers:

Forward and reverse feeds and forward and reverse rapid traverse are provided. Either hand or automatic control may be employed. Pipe connections with the gear pump are provided for operating fixtures or other auxiliary equipment. Different positions of the control valve give full speed (rapid approach), feed forward, neutral, feed reverse and full speed reverse (rapid return). When used with a 3 7/8-inch cylinder, this pump has a feeding range of from 1.66 to 23 inches per minute and a reverse feed of from 3.32 to 46 inches per minute. The rapid traverse speed in either direction is 93 inches per minute. The maximum working pressure is 1000 pounds per square inch and the power consumption at maximum capacity is 2 horsepower. The drive shaft speed is 860 revolutions per minute or lower. The pump is about 19 1/2 inches high.

In Fig. 4 is shown a variable-delivery pump of larger capacity, which has an over-all height of 36 inches. This pump has a capacity of 3060 cubic inches of oil per minute at a pressure of 1000 pounds per square inch. At *A* is the seven-position control valve stem operated by a cam-plate on the carriage of the machine. The pipe connections to the ends of the feeding cylinder are shown at *B*. This pump provides two feeding speeds and rapid traverse in either direction.

Hydraulic Feeding Units and Circuits

In Fig. 5 is shown a hand-controlled feeding pump *A*, with its two-pipe connections leading to the two ends of the feed cylinder *B*. At the high points of the pipe lines are automatic air drains *C* with drain pipes leading back to the oil-pot.

Fig. 7 shows the pump *A* removed from its oil-pot, with the cover off. Control handle *E* operates the stroke-changing cam *G* through a train of gears *F*. Cam *G* rolls against a fixed roller *H*, and is held against the roller by a light spring in a small hydraulic plunger not shown. This changes the stroke of the multiple-plunger pump, giving a simple feed control system, around which various hydraulic systems have been developed. The unit comprises two separate pumps, a variable-delivery pump on the upper side of the baseplate, and a large gear pump on the lower side. The latter pump furnishes a large flow of oil for rapid traverse movements.

A typical application of the kind of pump shown in Fig. 3 is indicated by the diagram in Fig. 6. The control valve stem *A*, having five positions, is operated from cam-plates *B* and *C*. The actuating of valve *A* by means of the cams controls the flow of oil from the variable pump to the feed cylinder and also controls admission of oil from the gear pump circuit for changing the stroke of the pump.

Rotary Drives for Long Strokes and Rotary Tables

When very long table strokes are required, as in the case of some types of grinding machines, or when the table has a rotary movement, as in some milling machines, it is desirable to use a rotary motor in place of the feed cylinder. Such a motor is shown in Fig. 8. The working parts of a motor of this type are identical with those of the corresponding variable-stroke pump. The displacement of this motor is 4.6 cubic inches per revolution; and the maximum torque, 690 inch-pounds at 1000 pounds per square inch. The maximum speed is 860 revolutions per minute, and the output at this speed, 9.4 horsepower.

Operating Multiple Feeds

To have complete individual speed control of two or more hydraulic cylinders or motors, each cylinder must be driven by its own pump and the entire flow from the pump must go through that cylinder. However, drilling machines of the multiple-spindle type having several feed cylinders operated simultaneously by oil supplied by a single gear pump have proved practical. If sufficient oil is pumped at all times, so that under the worst condition of usage there is still a slight amount being by-passed through the relief valve, the rate of movement of the piston of any one cylinder can be changed without any material change in the rate of travel of the others.

If the volume of oil delivered is not sufficient to maintain the pressure adjusted by the by-pass valve in the case of two or more motors or cylinders operated in parallel, the motor or cylinder encountering the least resistance may take the entire flow until its stroke or work is finished or stopped by closing a valve. The remaining units will operate successively according to the order of their resistance values. The total time required for all the cylinders to perform this work under this condition will be the same as though they operated simultaneously, assuming, of course, that the volume of oil delivered by the driving pump is the same. By employing a variable-delivery pump for changing the volume of oil flow in a system of this kind, the operator can obtain any desired feed for each cylinder as it comes into operation.

Cylinders Operated in Series

If the speed control required on two cylinders is simultaneous and proportional, the two cylinders may be placed in series in a closed circuit with a single pump. Such a circuit with the three pumps in series is shown diagrammatically in Fig. 9. This circuit is applicable to a way drill with three drilling heads.

The movement of such heads may be coordinated mechanically by racks and pinions or by linkage, but the hydraulic method is more flexible, less liable to damage through breakage, and in some cases, cheaper. The three cylinders must be graduated to the speed requirements of the heads. If one head is to move twice as fast as another, its cylinder must have one-half the volume. Also, each cylinder must be so designed that the volume displaced in its piston-rod end is equal to the volume displaced in the head end of the next succeeding cylinder. This is evident from the diagram, as the oil supplied to the head end of each cylinder after the first one, comes from the rod end of the preceding cylinder.

In order to keep the movement of such a set of pistons properly coordinated, the pistons must run

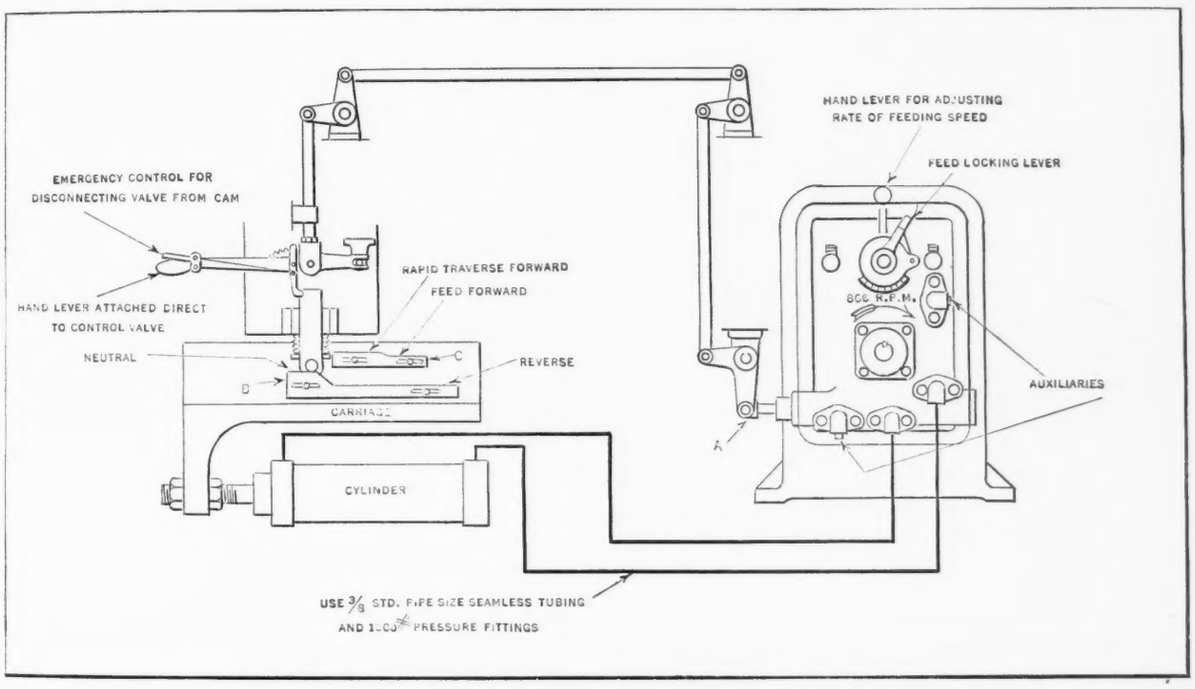


Fig. 6. Method of Operating Control Valve of Pump Shown in Fig. 3

against their cylinder heads at the termination of each cycle, so that they always start the next cycle in the same relation. The relief valves *A*, *B*, and *C*, Fig. 9, permit oil to pass around any piston that has stalled against its cylinder head during the back stroke, thus bringing all the pistons successively back against their cylinder heads.

Use of Multiple Transmitter

The series circuit of Fig. 9 divides the total working pressure into as many parts as there are cylinders. This reduces the maximum working pressure available in each cylinder, and tends toward large cylinder diameters. For this and other reasons, it is sometimes better to use a multiple transmitter, consisting of one double-acting cylinder reciprocated by the pump and operating several cylinders whose piston-rods are attached to a single cross-head. Each of these secondary cylinders acts as a pump or impeller for its own individual driven or feeding cylinder. This system establishes several separate closed hydraulic circuits, each of which operates its feeding cylinder at definite speeds, the pressure in each separate circuit depending on the resistance against the piston-rods of the respective feeding cylinders and on the corresponding piston areas.

The strokes of all the impelling cylinders are the same, but their diameters and the diameters of the feeding cylinders may be varied to give any desired feeding forces and strokes to the respective feeding cylinders, provided the totals are within the power capacity of the pump. All speed variations and distances traveled by the pistons of the respective feeding cylinders are proportional to the speeds and distances traveled by the piston of the main cylinder connected to the pump.

In this case also, it is necessary to provide means similar to those shown in Fig. 9 for bringing each of the feeding cylinders against this cylinder head at the end of every cycle to keep the pistons in coordination. A system of this kind is indicated in Fig. 10, only the principal circuits being shown. In practice, the circuits of both Figs. 9 and 10 require low-pressure make-up lines from the pump to each circuit, and other details, which are omitted for the sake of clearness.

Slip and its Effect

A tool-holder fed by an oil-pressure piston and a volumetric pump cannot be used to chase a thread, because its rate of feed is not absolutely constant. There is always a certain amount of leakage (across the bridges and through the plunger fits) in the pump, and this leakage is greater as the cut becomes heavier and the oil pressure rises. If the feed is low, in inches per minute, this leakage may be a considerable percentage of the pump delivery. This is the "slip," and in the early designs of hydraulically fed tools, was generally assumed to be a defect. Geared feeds do not slip, and the tool must cut the given thickness of chip, whether the material is hard or soft, the cut deep or shallow. If the tool manages to back off slightly due to "windup" in the rods and gearing, the lost travel must be made up, and the average thickness of chip throughout the cut must be equal to the geared feed rate.

If the tool is fed by oil from a volumetric pump, it will never move faster than the nominal feed rate, but higher pressures will cause the feed to slow up. The travel lost by this increased slippage is never made up. Hence the tool is not damaged by being forced to maintain the given feed rate, as may be the case when overload causes winding up of the mechanical feed gear.

The rate of leakage in a hydraulic feeding system depends upon the pressure, and the pressure is directly caused by the resistance encountered by the tool. Consequently the flow of oil actually delivered by the pump into the feeding cylinder is less as the resistance increases. In actual practice, this reduction of feed with increasing pressure may be

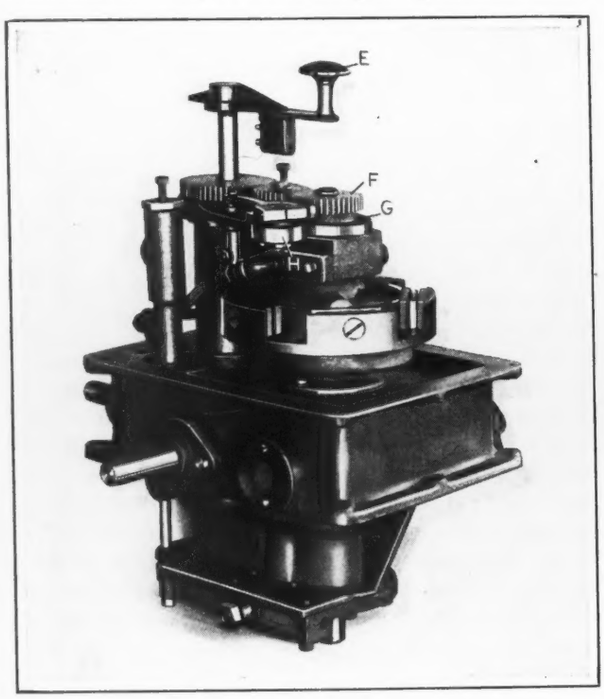


Fig. 7. Pump Shown in Fig. 5, Removed from Its Oil-pot

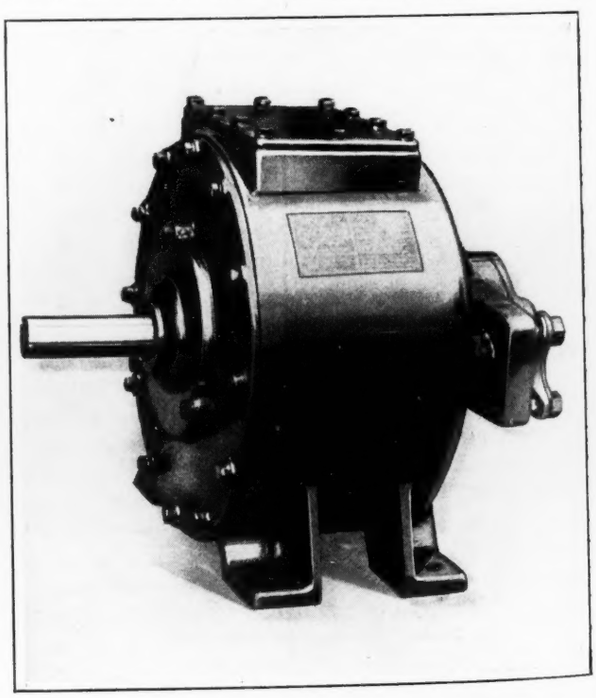


Fig. 8. Constant-displacement Hydraulic Motor

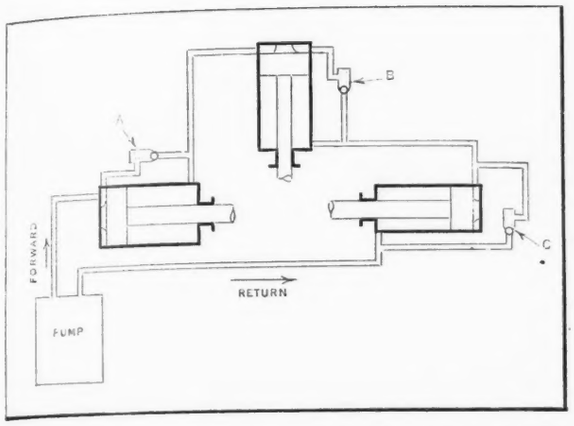


Fig. 9. Diagram of Cylinders Operated by Series Circuit

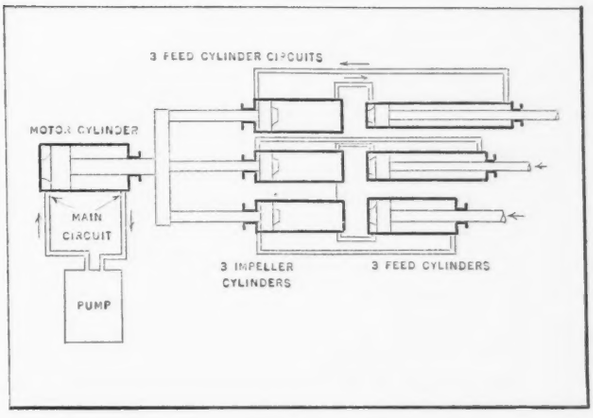


Fig. 10. Diagram of Multiple-impeller System

a very significant fraction of the theoretical feed rate, especially with heavy cuts at slow feeds.

For instance, a standard 3 7/8-inch diameter feed cylinder has a piston area of 11.8 square inches and can deliver a net feeding force of 11,800 pounds to a cutting tool. When working at this maximum pressure of 1000 pounds per square inch, the slip of the entire apparatus would quite likely amount to 15 cubic inches of oil per minute. In ordinary cuts, such a feeding cylinder usually operates at pressures of 250 or 300 pounds per square inch, and the slip is, say, 5 cubic inches per minute.

Therefore, if the feed were adjusted to give 4 inches per minute under 250 pounds pressure, the additional slip of 10 cubic inches of oil as the pressure rises to nearly 1000 pounds would reduce the rate of feed by nearly 7/8 inch per minute, leaving a net feed of about 3 1/8 inches per minute during the excessively heavy cut. This amounts to a 20 per cent reduction in the 4-inch per minute rate of feed. If the feed rate were set at 16 inches per minute, the reduction would be 5 per cent, as the amount of slip is practically constant for given pressures. These rates are based on a type of pump having relatively large leakage through a distributing valve. Other types would show about one-half as much slippage.

* * *

DIMENSIONS OF KNURLED WORK

By HENRY SIMON

There is no lack of information in regard to the dimensions of the various kinds of knurl rolls, but for some reason, little seems to be known of the dimensions of the work produced by these tools. It is often taken for granted, for instance, that the knurling on the product is of the same height as the teeth on the roll, and that the knurl tool rolls "down as much as up," or in other words, that the difference between the blank diameter and the knurled diameter is equal to the difference between the blank diameter and the root diameter. These assumptions are wrong, and while ordinarily such errors are of no consequence, there are cases in which the contrary is true and calculations based on such false premises may lead to trouble and delay production.

The writer offers the following figures, which, while tried out on diamond knurling and upon a limited range of diameters only, possess the advantage of having been thoroughly tested in actual practice. Because of the peculiar action of knurling, which renders it easily susceptible to the influence of various changeable factors, such as composition of stock, lubrication, and wear on knurl rolls, no data of this kind will ever be altogether exact, but these figures will be sufficiently accurate for practical purposes. The formulas are for finding the diameters of diamond knurled work from 95 to 100 per cent fully developed, on automatic screw machines, using a turret holder, when the diameter of the knurl roll is 3/4 inch; the angle included between the teeth, 90 degrees; the circular pitch, 0.035 to 0.042 inch; and the blank diameter of the work from 1/2 to 13/16 inch. The formulas are,

$$B = K - 0.75D;\ K = B + 0.75D$$
$$R = B - D;\ B = R + D$$

where B, K, and R are the blank, knurled, and root diameters, respectively, of the piece, and D is the depth of tooth of the knurl roll.

For example, let it be assumed that the outside of 3/4-inch stock is to be diamond-knurled with 3/4-inch rolls of 68 teeth, and that it is required to find the knurled diameter.

The depth of tooth $= 0.0175$ inch

$$K = 0.750 + 0.75 \times 0.0175 = 0.763 \text{ inch}$$

We are also to form so as to just clean up on the knurling. How much must be allowed for feeding in the form tool?

$$R = 0.750 - 0.0175 = 0.7325 \text{ inch}$$

We must form to a depth of 1/2 D or 0.00875 inch. To this figure should be added not less than 0.0025 inch to allow for eccentricity and to avoid the "shadow" otherwise appearing on the formed surface by the crushing action of the knurl, which is noticeable for a thousandth inch or so below the root diameter.

The figures given would probably not be materially affected by changes of feed, except extremes, and undoubtedly would hold true, within reasonable limits, for smaller or larger work, where the relative dimensions between roll, size of tooth, and work remain unchanged.

* * *

Few materials apparently differ more in their properties than a rubber band and a hard rubber panel for a radio cabinet; yet both of these are made from the same rubber and sulphur. One contains from 3 to 5 per cent sulphur and the other from 25 to 32 per cent.

Locomotive Cross-head Babbitting Fixture

By H. H. HENSON, Machine Shop Foreman, Southern Railway Co., Chattanooga, Tenn.

THE accompanying illustrations show a fixture for babbitting locomotive cross-heads which can be adjusted to accommodate different sizes. In Fig. 1 the operator is shown in the act of babbitting a cross-head for a large type Santa Fé locomotive. The guides for which this cross-head is being babbitted are 7 inches wide, and the distance between their faces is 18 1/2 inches. The babbitt is cast to size in the fixture and requires no machining on the planer or shaper.

Adjusting Fixture for Width

Referring to the assembly view, Fig. 2, the two uprights *A* are first adjusted the proper distance apart for the cross-head to be babbitted, making sufficient allowance for running clearance. This adjustment is made by means of a screw *B* which has right- and left-hand square threads. The two uprights are, therefore, universal in their adjustment, being moved out or in simultaneously when the screw is turned by means of either of the hand-wheels *C*. The mandrel *E* is fitted with a sleeve *D*, Fig. 1, which fits the tapered hole in the cross-head to be babbitted. As the fit of the piston-rod in the tapered hole of the cross-head is not the same for all cross-heads, it is essential that several sleeves, with tapers varying from 3/4 inch in 12 inches to 5/8 inch in 13 inches, be kept on hand. This range of sizes covers the usual standards that are employed in modern locomotive construction. The proper sleeve is selected by trying the different sizes in the tapered hole in the cross-head until one is found that has the required fit.

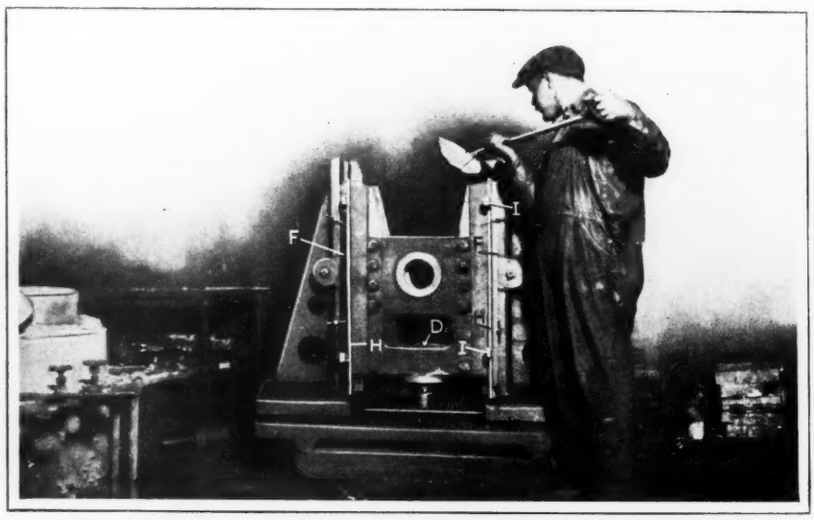


Fig. 1. Babbitting Cross-head for Locomotive

Adjustment for Width of Guide

The next operation preparatory to mounting the cross-head in the fixture is the adjustment of the taper wedges *F* to the width of the guides, plus 3/32 inch for running clearance and to allow for the expanded condition of the preheated cross-head at the time of pouring the hot metal.

By the time the cross-head is cool, it will have a running clearance of about 3/64 inch on the guides. A wrench applied to the squared ends of the pinion shafts *G* is used to adjust the wedges *F* to the required width. The wedges, four in number, are made of good steel forgings, and each has a 10-pitch rack which meshes with a pinion, as shown in the cross-sectional view *X–X*. The shape of the back side of the wedges is shown in this cross-sectional view. The mandrel or plunger *E* is next adjusted to raise the cross-head so that mud or asbestos can be used to prevent the hot metal from running out of the cross-head during the pouring operation. After the proper adjustments have been made, the fixture is ready to receive the cross-head, which is next prepared for babbitting.

Preparing Work for Babbitting

To make a successful job of babbitting, the cross-head gibbed part, or rather the portion where the guides ride, must be at least 3/8 inch wider than the guide. This allows for the running clearance and a coat of babbitt metal 5 32 inch thick on each side of the guide in the cross-head, and is sufficient to take care of wear.

The cross-head is placed in the babbitting furnace, where it is immersed in the melted babbitt for the double purpose of removing the old metal and preheating it for tinning with muriatic acid. The surface can then be covered with a uniform coating of solder, or tin, as it is commonly called in the shop. This operation requires considerable care, as the whole surface must be tinned before the cross-head is placed in the fixture, as shown in Fig. 1.

After the work is placed in the fixture, wooden strips *H*, Fig. 1, are inserted between the cross-head and the flanged portion. These wooden strips are held in place by small wooden wedges *I*. The bottom part of the cross-head is "mudded" or sealed with asbestos applied next to the tapered wedges. This, together with the wooden strips, serves to keep the molten babbitt from running out of the cross-head during the pouring operation.

Pouring the Babbitt

The hot metal is poured into the cross-head from a ladle of sufficient size to allow one side of the cross-head to be completed without refilling. After the cross-head has been babbitted and the metal

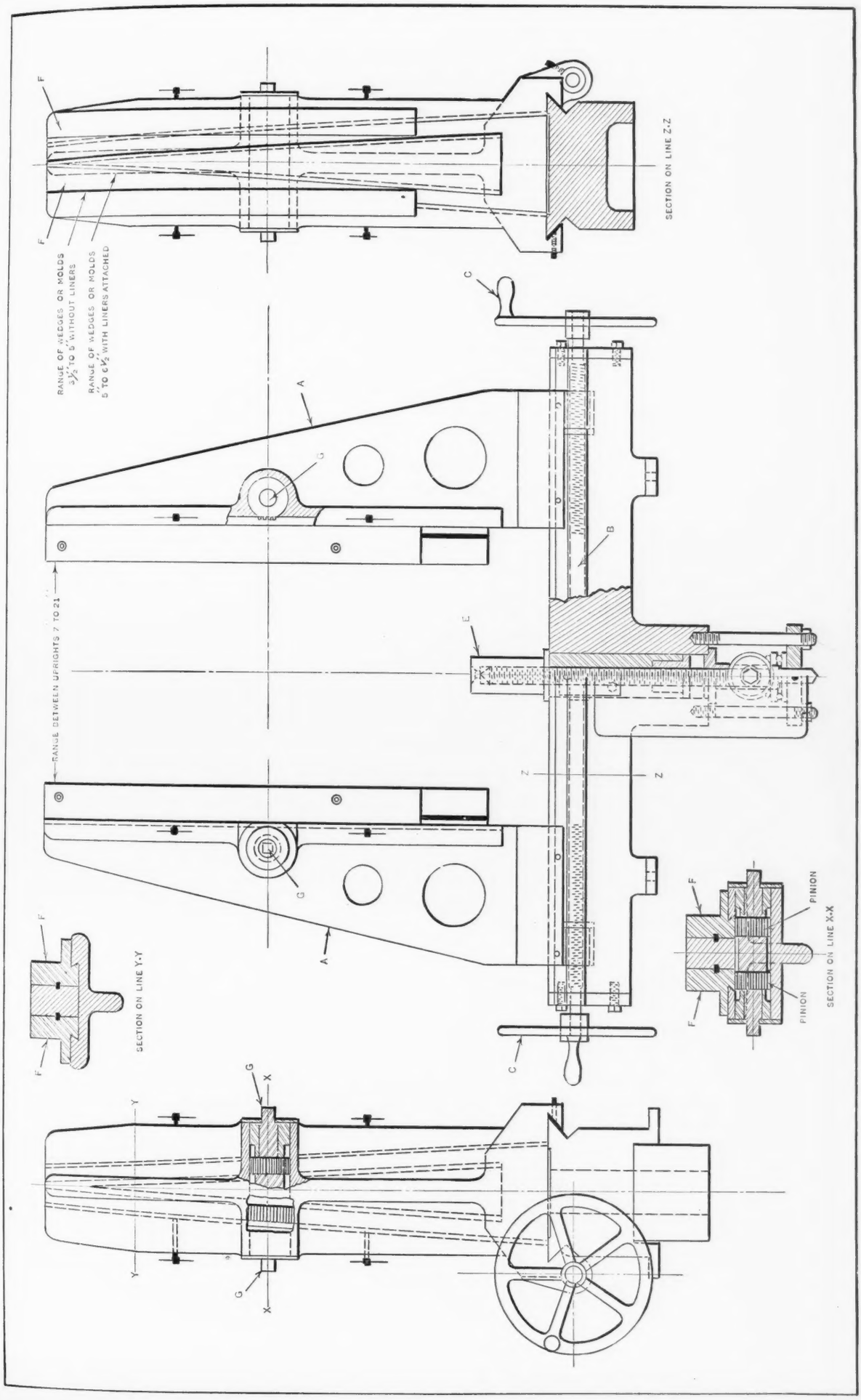

SECTION ON LINE Z-Z
RANGE OF WEDGES OR MOLDS 3/4" TO 5" WITHOUT LINERS
RANGE OF WEDGES OR MOLDS 5 TO 6 1/2" WITH LINERS ATTACHED
RANGE BETWEEN UPRIGHTS 7 TO 21"
SECTION ON LINE Y-Y
PINION
PINION
SECTION ON LINE X-X

Fig. 2. Assembly Views of Babbitting Fixture Illustrated in Fig. 1

cooled, it is necessary to break the babbitt metal loose from the uprights or molds formed by the wedges. This is accomplished by means of a 30-ton jack, fastened to the bottom of the fixture. This jack is actuated by a ratchet and lever.

After the cross-head has been broken loose from the molds, it is an easy matter to hoist it from the fixture by means of an air or chain hoist located over the machine on a jib crane. This method of babbitting cross-heads to the finished dimensions has proved very successful and has cut the cost materially, as the operation requires only about fifteen minutes, floor-to-floor time. The use of the babbitting fixture, as described, prevents delays in the engine house and also releases the planer or shaper for other work, since it is unnecessary to plane the babbitt to size.

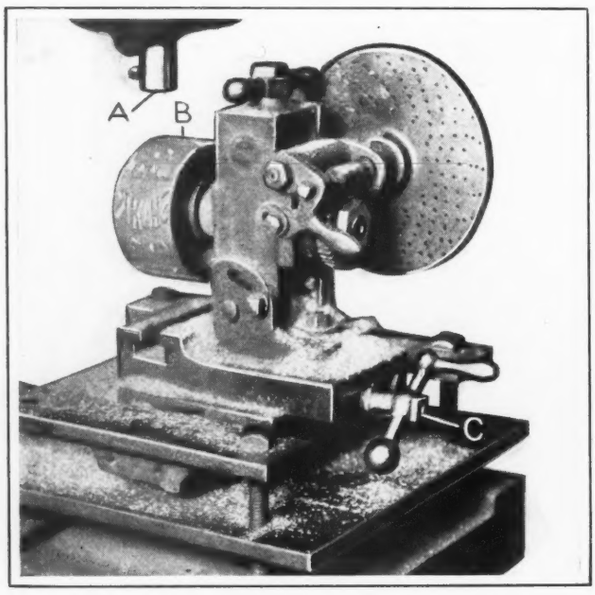
* * *

ROUTING LETTERS ON PRINTING ROLLS

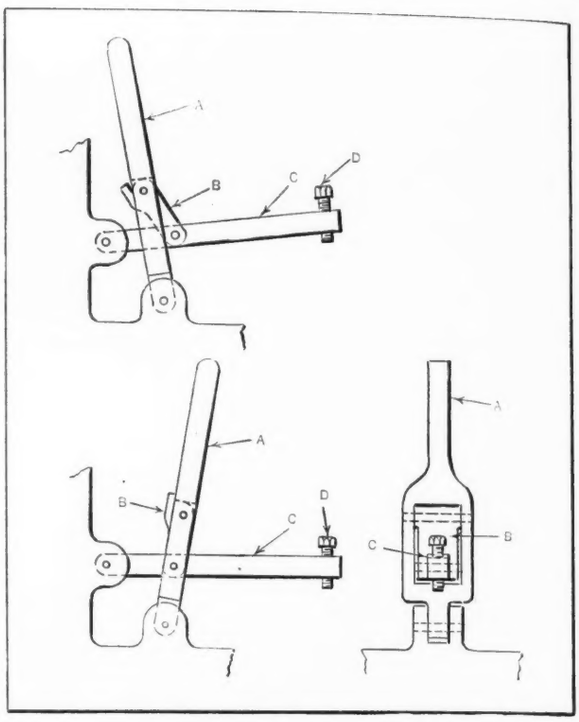
By AVERY E. GRANVILLE

The interesting device shown in the accompanying illustration is used in a small job printing shop for routing out the metal around letters on type metal printing rolls. These rolls are cast to shape, turned smooth on the outside, and the desired letters or characters are scribed or drawn on the turned surface. The roll is then mounted on the spindle of the device and the metal cut away from around the characters. The cutting is done with a three-cornered engraving or routing cutter held in the machine spindle at *A*, the roll *B* being mounted on the fixture as shown.

The device used for manipulating the roll under the engraving cutter is made up of an old milling machine dividing head mounted on a discarded lathe cross-slide. The cross-feed screw *C* gives the necessary movement in a plane at right angles with the axis of the spindle, while the circular movement is obtained by means of the indexing handle on the dividing head. A little practice is required to operate the device, but when the workman once becomes familiar with it, the routing can be done quickly and accurately.



Device Used for Routing Letters on Printing Roll



Clamp for Holding Sheet-metal Part

QUICK-ACTING CLAMP

By R. H. KASPER

A quick-acting clamp used on a fixture for holding sheet-metal parts in position for welding is shown in the accompanying illustration. The levers *A* and *C* are pivoted in the body of the fixture and are connected by the link *B*. The clamp is shown in its open position in the upper view. Lever *C* carries an adjusting screw *D*, for setting the clamp to hold metal of varying thicknesses.

In the lower view, lever *A* is shown brought forward so that it causes the link *B* to recede into the opening in the lever, forcing the lever *C* downward. The upper end of link *B* has a projecting lug that comes in contact with lever *A* and thus limits its movement. The end view in the lower right-hand corner of the illustration shows how lever *B* is contained within lever *A* when the clamp is closed.

* * *

In connection with the fiftieth anniversary number of the *American Exporter*, it is pointed out that fifty years ago, all but 17 per cent of the vessels entering the port of New York were sailing vessels. There were at that time fifteen trans-Atlantic passenger lines with ships entering New York; of these, seven are still in existence. The largest trans-Atlantic liner of that day was 4500 tons.

* * *

An address by Irving S. Paull on "The Folly of Selling Goods Below Cost," which was presented before the tenth annual meeting of the National Coal Association, has been reprinted in pamphlet form. This address applies to any industry, and those interested can obtain copies by addressing the National Coal Association, Southern Bldg., Washington, D. C.

SPECIAL CHUCK FOR SMALL BRASS GEAR BLANKS

By B. J. STERN

The small brass casting *Z*, shown by heavy dot-and-dash lines in Figs. 1 and 2, is the blank for a gear used in the mechanism of a water appliance. Since large quantities of these gears are needed, it is important that the blanks be machined before the teeth are cut, in as economical a manner as possible. A Brown & Sharpe automatic turret lathe equipped with the special chuck shown in Fig. 1 and the loading fixture shown in Fig. 2 are used for machining the blanks.

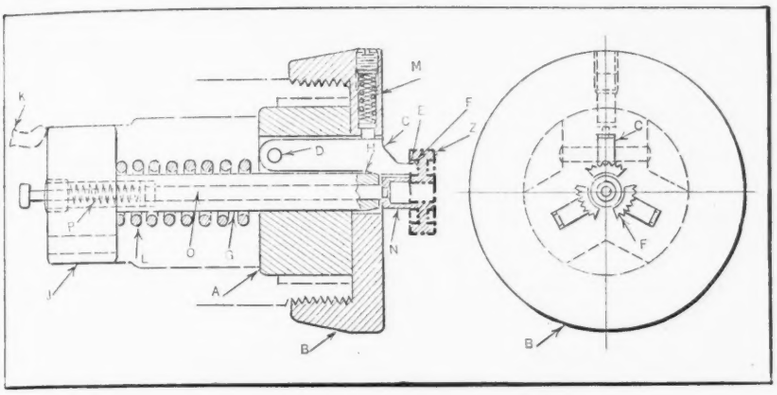


Fig. 1. Chuck for Holding Gear Blanks

The chuck jaw plate *A*, Fig. 1, is seated in a recess in the spindle of the machine, and is kept in place by the ring *B*, which is screwed on the spindle nose of the machine. This ring forces plate *A* against the shoulder in the spindle. Three equally spaced slots are cut in plate *A* into which are fitted the jaws *C*, which pivot on the pins *D*. These jaws, extending from the face of ring *B*, are so shaped at the ends *F* that they fit the casting under the rim *E*, leaving the outer periphery of the work and the sides clear for machining. In order to give the jaws a better grip on the rough casting, the holding ends of the jaws are serrated, as shown at *F* in the end view, Fig. 1.

The jaws are expanded to grip the work by means of the hardened steel plunger *G*, which is a sliding fit in plate *A*. This plunger is tapered at one end to fit a corresponding taper at the back of the jaws at *H*. The plunger is pushed forward by the head *J*, which is a sliding fit in the spindle of the automatic machine. Head *J* is so positioned that it is actuated by the cam *K* of the machine, which imparts a forward movement to it when the chuck-closing portion of the operating cycle is reached.

At the end of the machining operation, when the pressure against head *J* is released, the spring *L*, which has been under pressure meanwhile, serves to pull back plunger *G*, thus allowing the chuck jaws to be pushed back from the work by the springs *M*, one of which is placed directly in back of each jaw. When the casting is placed in position over the jaws, it pushes back the bushing *N* which is attached to the rod *O*. This results in compressing the spring *P*, which is contained in the plunger head *J*. When the work is released, the expansion of spring *P* causes bushing *N* to force the work from the jaws.

Since all the operations on the machine are entirely automatic and controlled by cams, it is essential that the work be loaded into the chuck by an automatic device, in accordance with a predetermined cycle of operations. To accomplish this, the automatic loading fixture shown in Fig. 2 was designed for use in the turret of the machine, where its action could be controlled by the turret cam. The shank *A* of the body *B* of the loading fixture is gripped in the turret. At the outer end of body *B* is a bearing *C* on which is fitted the collar *D*. The bearing *C* is a sliding fit in body *B* and on the stud *F*.

In back of bearing *C*, is a thrust bearing *H*, which is kept tightly pressed against bearing *C* by the spring *J*. The casting, shown at *Z*, is thrust into the hole in the collar *D* by the operator. This action forces the three equally spaced balls *K* outward. The stiff springs *L*, which back up the balls *K*, exert sufficient pressure to retain the work *Z* in a central position in collar *D*. In the course of the work cycle, the turret is tripped by a cam to bring the work in line with the chuck, at which point it is advanced until it is pressed on the chuck jaws.

The turret, which still continues to advance, causes the jaws of the chuck to press against the work which, in turn, presses against the ring *C*, Fig. 2, causing the latter member to slide back in the hole in body *B*, which results in compressing the spring *J*. At this point, the turret ceases to advance and dwells until the chuck is closed and starts rotating. The work, rotating with the chuck, tends to rotate the collar *D*. It is at this point that the thrust bearing *H* comes into use and allows the chuck to rotate freely while the thrust of the turret acts against the chuck jaws. When the work is firmly gripped and rotated for one or two seconds, the turret ceases to dwell and is brought back by its actuating cam. The finishing operations are performed by standard tools.

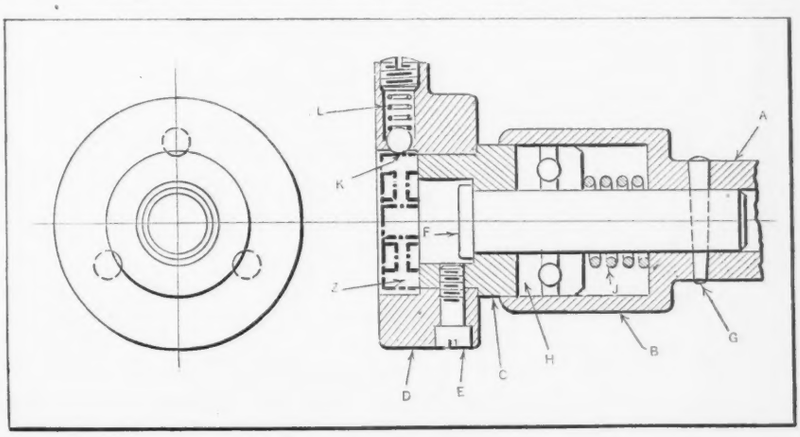
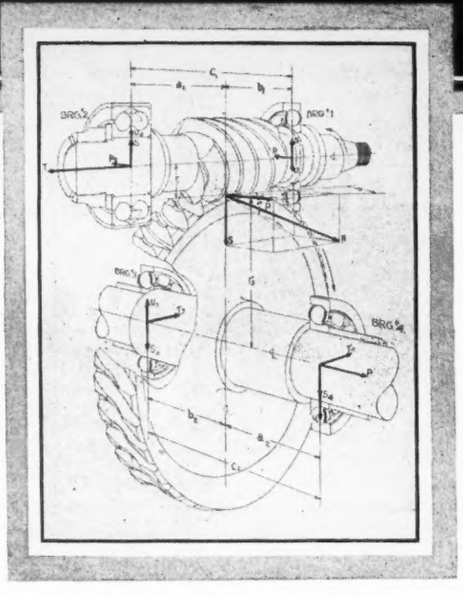


Fig. 2. Device for Placing Work in Chuck

Principles of Perspective Drawing



By PERRY N. DEMING,
Engineering Department, New Departure Mfg. Co., Bristol, Conn.

IN the first installment of this article, published in January MACHINERY, typical examples of the procedure followed in making perspective drawings were given. The present article gives further examples to illustrate the principles underlying perspective drawing.

Fig. 21 shows a bench miller drawn in perspective. Lengths and widths are laid off on the base line and heights on line *EI*, as usual. The method of locating the cone pulleys and one or two other parts is indicated. Figs. 16, 17, 18, and 19 show a number of kinks that can be used to save time.

Fig. 16 illustrates a simple kink which is particularly useful in perspective drawing. When two points are to be connected, simply place the pencil on one of them. Rest the end of the straightedge lightly against the pencil and swing the straightedge up to the other point; the pencil is now in a position to draw the required line without lost motion.

Fig. 17 shows that lines drawn from the corners of a perspective parallelogram intersect in the perspective cen-

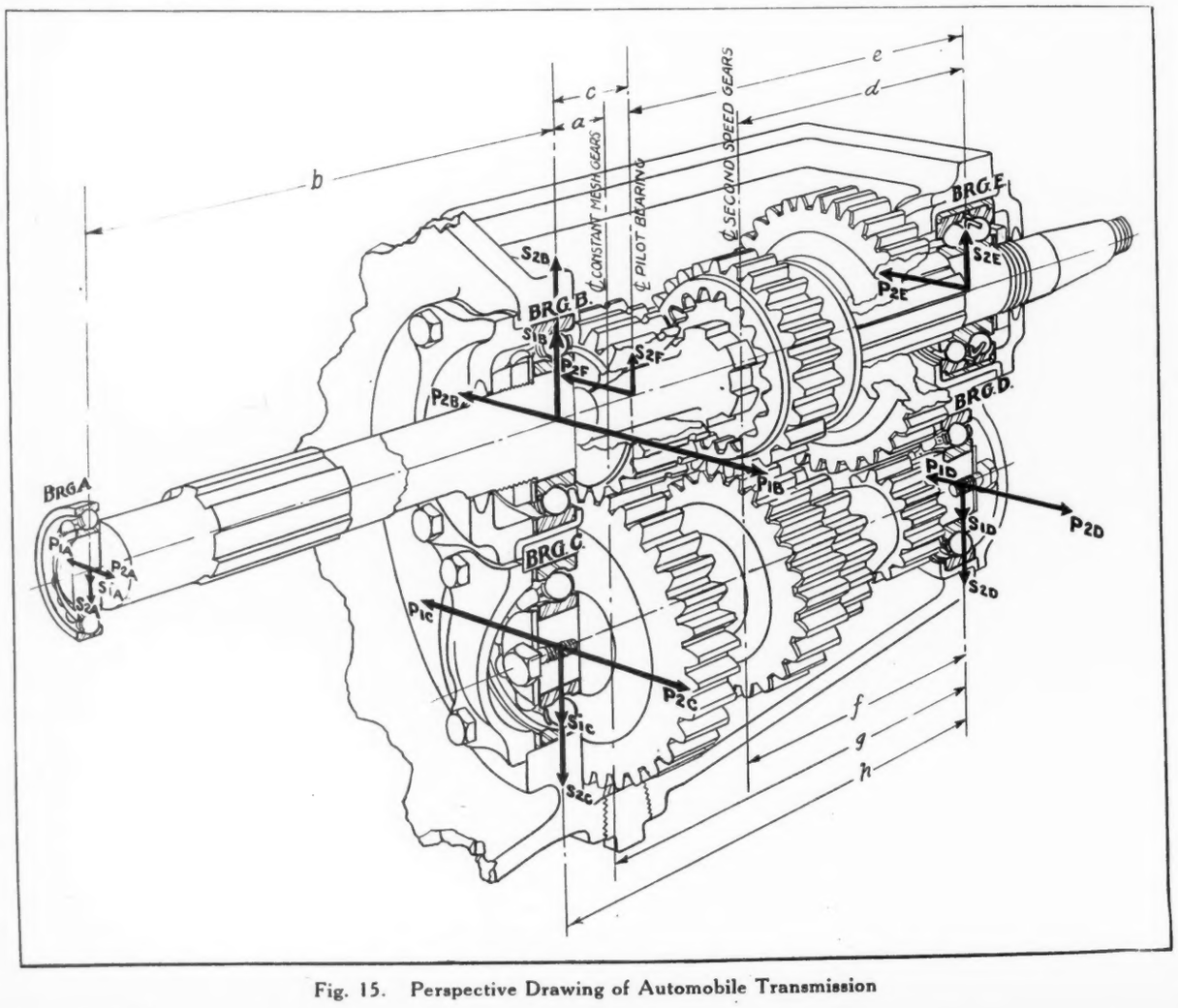
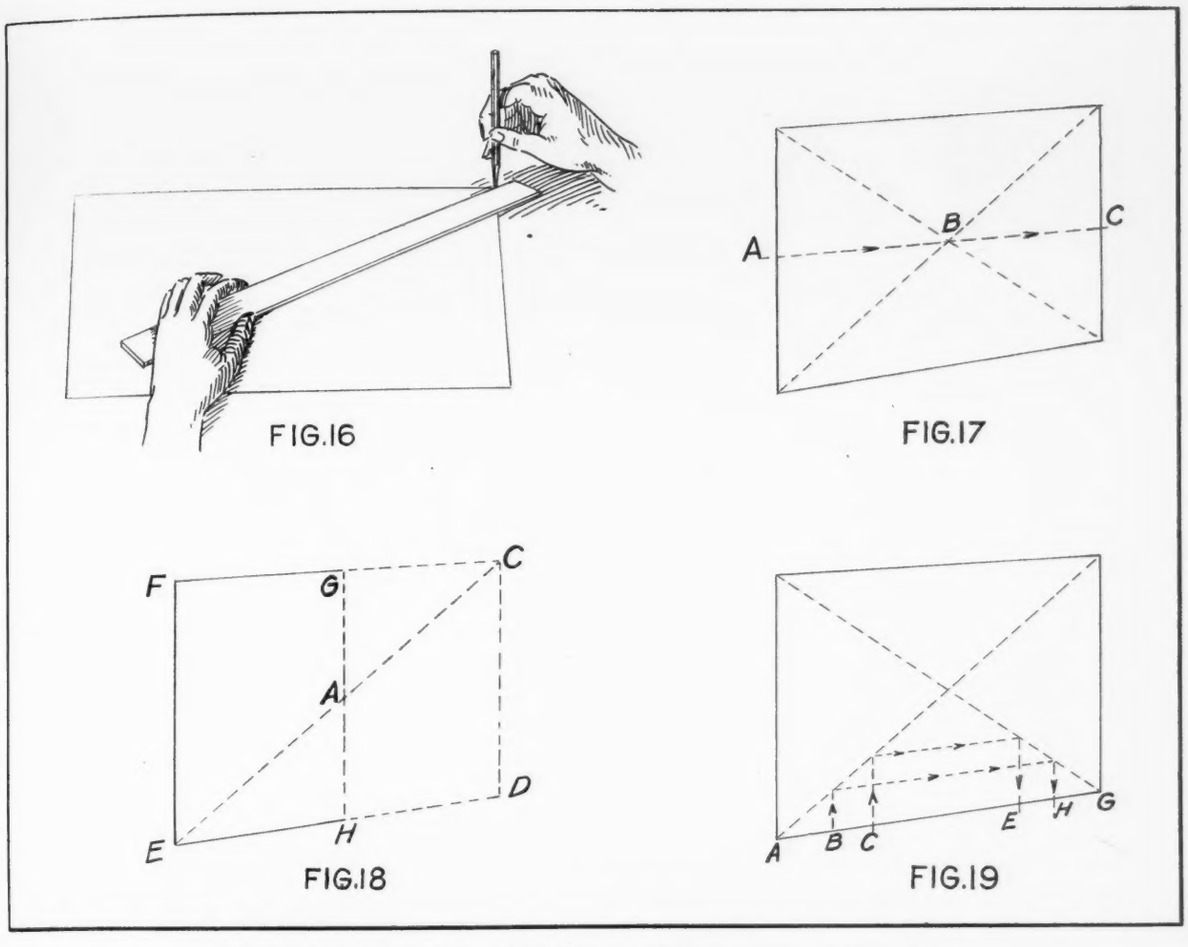


Fig. 15. Perspective Drawing of Automobile Transmission



Figs. 16, 17, 18 and 19. Useful Kinks in Making Perspective Drawings

ter. Of course, *AB* is greater than *BC* on the paper. In Fig. 18 a rectangle *EFGH* is drawn in perspective. To add to the rear of this another rectangle which will appear the same size in perspective, we draw line *EC* through *A* which is the middle point of *GH*, drop a vertical line from *C* to *D*, and complete the rectangle.

Sometimes, there are so many points to project from a base line that it is desirable to locate as many points as we can from previously located points on the perspective figure itself. In Fig. 19, points *B* and *C* are located as usual. To locate *E* and *H*, which are as far perspectively from *G* as *B* and *C* are from *A*, use the diagonals as shown.

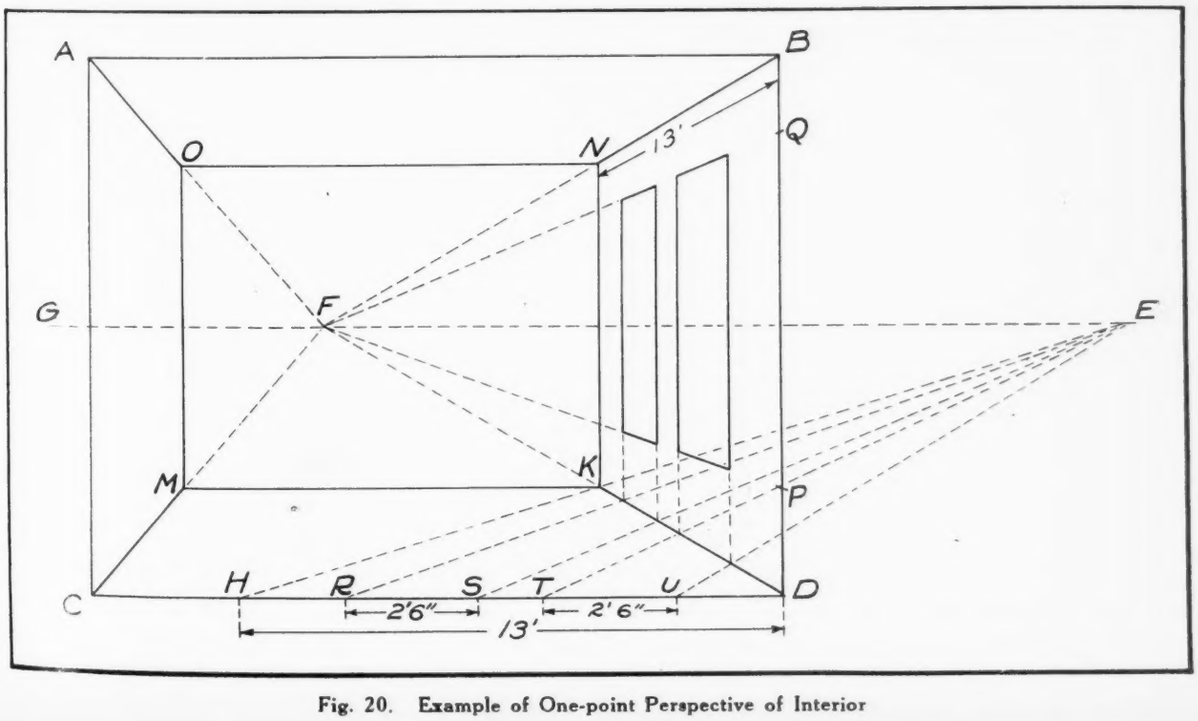


Fig. 20. Example of One-point Perspective of Interior

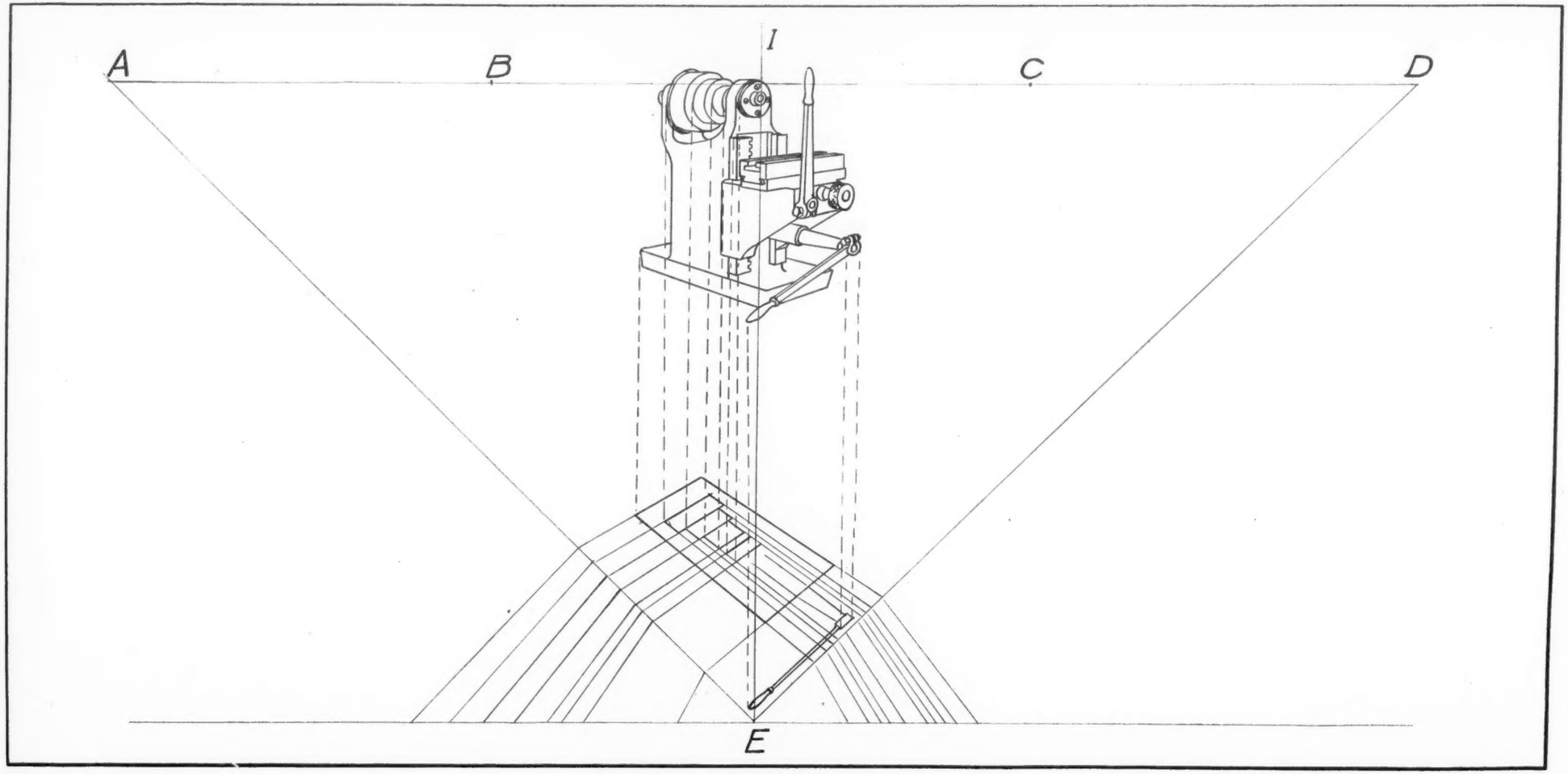


Fig. 21. Bench Miller Shown in Perspective

Fig. 20 is an example of one-point perspective which may be necessary to represent an interior of an office or shop. Points *ABCD* are the near corners of a room. The room is 13 feet deep. Point *F* is located 5 feet (in scale) above *CD*, or about where the level of the observer's eyes would be, and near the center of the rectangle. If we wish to show the right- and left-hand walls equally, *F* would be exactly in the center (from left and right). A line is drawn horizontally through *F* and continued to *E*, which is about half the distance *CD* from line *BD*. Then diagonals are drawn toward *F* from *A*, *B*, *C*, and *D*. Next, the distance (in scale) that we want the depth of our room to be, is measured off from *D* to *H*—in this case the distance is 13 feet. Then *HE* is drawn to intersect *FD* at *K*. Finally, the rectangle *KMON* is completed, using *K* for one corner.

The heights *PQ* of the windows are laid off on *BD* and projected toward *F*, as shown. The widths and positions of the windows are determined by the distances laid off from *R* to *S*, *S* to *T*, etc.

Fig. 22 is drawn to show a carrying forward of this method; this example also shows that *E* may be at the left and that points may be measured from *D* and projected toward *E* with the same result as in Fig. 20.

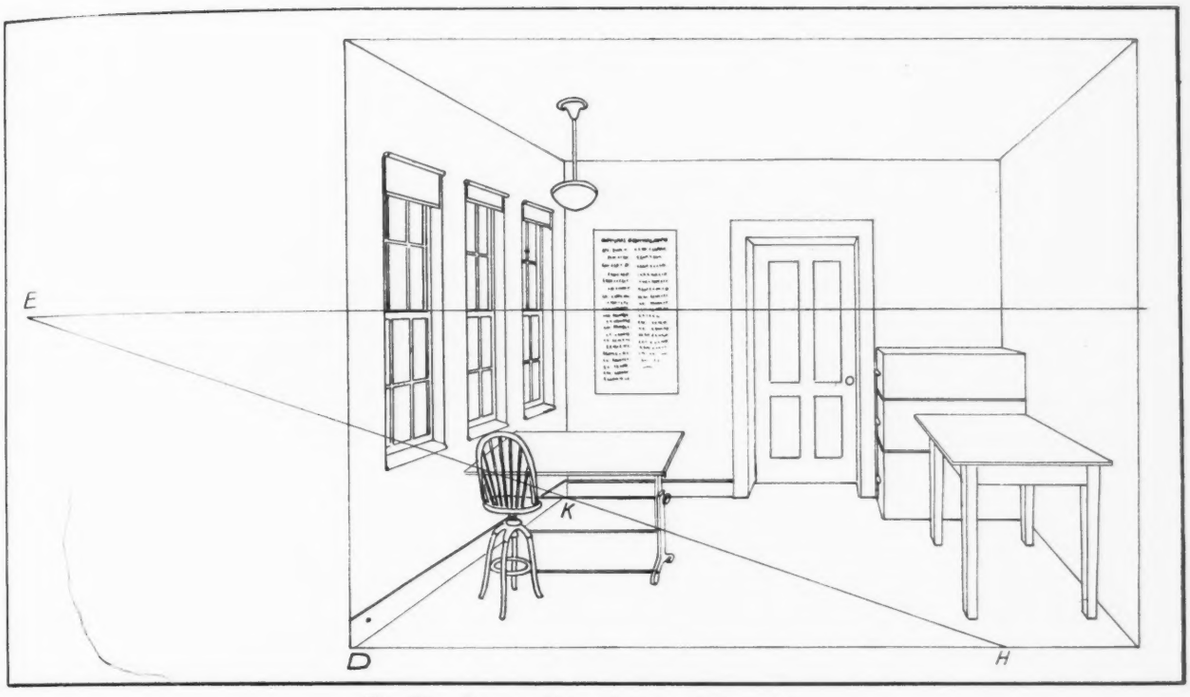


Fig. 22. Interior View Shown in Perspective

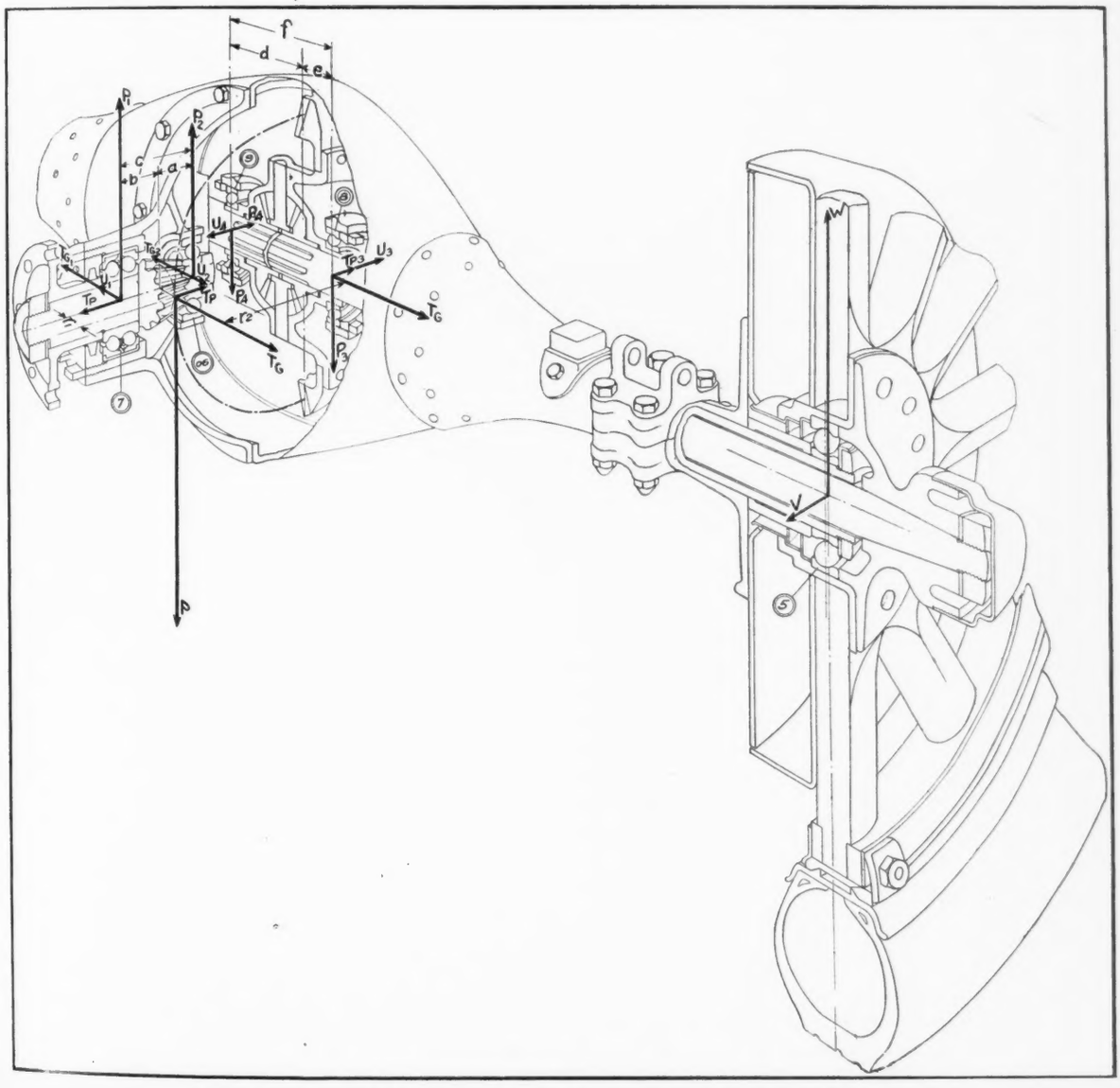


Fig. 23. Automobile Differential and Wheel Sections Shown in Perspective

There are many books written on perspective drawing, but the few examples shown probably will enable the average draftsman to represent in one view what, in ordinary practice, would require several views.

The heading illustration and Figs. 15 and 23 are examples of perspective drawing of assemblies made in accordance with the principles and methods described and illustrated in this article. It is apparent that several regular mechanical drawings would be required to give all the information clearly shown by one perspective drawing of this kind.

* * *

TREATMENT OF HEAVY STEEL STAMPINGS

In a paper by J. A. Maguire, read before the annual meeting of the staff and field representatives of the Oakite Products, Inc., reference was made to the removal of drawing compound from heavy steel stampings. The steel used for heavy-gage stampings is not generally oiled at the mill, like light-gage steel, and therefore often becomes quite rusty before it is ready for use. The rust is removed in a sulphuric acid pickle, but the acid is not generally neutralized. Hence, the surface of the steel at once begins to corrode, although it could not be called rusty by the time it reaches the presses. However, by the time the stampings reach the cleaning tank, which may be a week or two later, they have become rusty, but as they are covered by the drawing compound, the rust shows up only where the compound is removed. The stampings must then again be pickled to remove the rust, and the pickle must be neutralized to prevent further corrosion. To get the best results, according to Mr. Maguire, there should first be a cleaning tank, a hot rinse tank, an acid tank, a cold rinse, and finally a hot rinse, to which a small amount of oakite has been added.

"It may be asked," said Mr. Maguire, "why the acid is not neutralized after pickling the sheets, and before stamping, thus preventing all this rust? This corroded, yielding surface on the sheets, however, is believed to be of as much aid to the dies in the drawing operation as the drawing compound itself. Experiments have shown that a smoother job is obtained by not neutralizing the first pickle."

* * *

A British manufacturer has recently tapped over 330,000 brass nuts, 3/4 inch long, with a 3/8-inch tap provided with British standard fine threads. The tap is said to be still in good condition and is in constant use. The tap, made by the S K F Industries in Gothenburg, Sweden, thus has actually threaded a hole in brass about four miles long. It would be of interest to record other unusual tapping performances.

WHEN TO DISCARD WIRE ROPE

When to discard wire rope as worn out, according to C. D. Meals, of the American Cable Co., is a question for which no definite rules can be supplied, as much depends on the local application of the rope and the degree of maintenance attention accorded it. The appearance of the wires cannot alone be taken as a criterion, since two ropes from the same reel, having the same degree of wear and number of broken wires, may show when tested a variation of 25 per cent in reserve strength. There may be several reasons for this variation; for example, that one rope may have been subjected to excessive acceleration stresses, which greatly fatigued the steel and caused considerable loss of strength. Another factor may have been the absence of proper lubrication, which greatly affects the degree of corrosion—not always visible. With these qualifications in mind, the following suggestions for the discarding of wire rope are given, with the thought that they may serve users of wire rope and increase the degree of safety of workers.

Wire ropes for shop cranes and electric or pneumatic hoists should be discarded when there are four or more broken wires in any one strand; when the outer wires have been worn to two-thirds of their original diameter; or when loss of area exceeds 15 per cent for combined wire wear and broken wires.

When employed in hoisting elevators for skips, the wire rope should be discarded when there are more than three adjacent wires broken in any one strand; when the outer wires have become worn to two-thirds their original diameter; or when marked corrosion appears.

The U. S. Bureau of Mines, in Technical Paper No. 237, advocates that after shaft ropes have been in service for a period of three years, even if idle, they shall not be used unless tested for ultimate breaking strength. The minimum factor of safety on a deteriorated rope for mine use should be 4. Any rope that has remained idle for some time should be cut off and the interior wires examined for possible corrosion and wear.

There are many places where life or limb will not be endangered, such as in car hauls, car transfers, spotters, hot beds in steel mills, etc. In such applications, a wire rope might conceivably be used until one entire strand of the rope breaks. But this general rule, of course, has no application to installations that might endanger workmen.

* * *

The day has long since passed when the benefits of any improvement in the processes between producer and consumer are for the exclusive advantage of one group. They must be shared to be of lasting value. That is one secret of our present advancement.—*Charles M. Schwab*

Fair Pay for a Fair Day's Work

In March MACHINERY, James M. Acklin, president of the Acklin Stamping Co., will describe in the article "Incentive Payment in a Stamping Shop" the features of a wage system that has functioned to the satisfaction of both employer and employe. Any wage system that will function satisfactorily must be equally just to both; and when, through careful planning of the work, adequate tools and equipment, and a fair system of incentive payment of wages, the management provides for the employes an opportunity for substantially increasing their earnings without undue exertion, production usually jumps up and costs are lowered correspondingly. This article outlines a system which can be applied in shops making a variety of products and should, therefore, be of unusual interest to managers of the great number of medium-sized shops in the country.

Machining a Cam Surface in a Drill Press

By J. E. FENNO

THE machining of the switch box control pad illustrated in Fig. 1 presented a number of interesting problems. Two operations, performed with fixtures of unique design, as described in the following, were the machining of the cam surface *A* and the drilling and tapping of the hole *B*.

Surface *C* and hole *D* of the pad had been previously finished in a turret lathe.

To machine the cam face, the pad is placed in the base *A* of the fixture, as shown in Fig. 2, which is bolted to the drill press table, concentric with the drill press spindle. The pad is centralized in the fixture by pin *B*. The pins *C* are placed along the long edge of the pad to prevent the pad from turning during the operation. Pin *D* serves as a stop to insure that the pad will be set in the fixture with the square projection of its long boss in the proper relation to the cam surface. Bolted and pinned to the base *A* is an extending plate *E*, which holds a hardened master cam *F*.

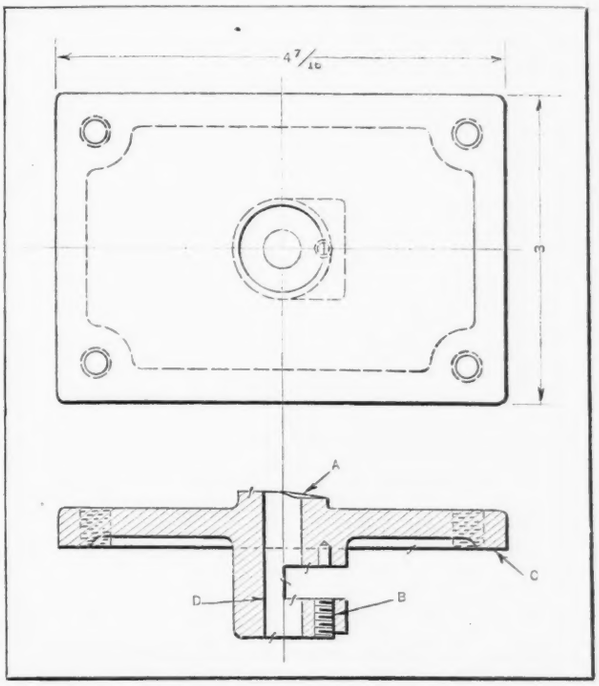


Fig. 1. Switch Box Control Pad Machined by the Use of the Fixtures Shown in Figs. 2 and 3

The short hub of the pad on which the cam surface is to be formed is first rough-faced with a standard counterbore, leaving sufficient metal for the finishing operation. When all the pieces in the lot has been rough-faced, the counterbore is replaced by the tool *G*. Tool *G* is made with a square body, a taper shank, and a pilot. At the lower end of this tool is a slot for the cutting tool *H*, which is held in place by the two hollow-head set-screws *J*. On one of the flats of the square body, at a suitable distance from cutter *H*, is mounted a roller *K* on shouldered stud *L*.

In operation, the tool *G* is fed down until the roller *K* contacts with the cam *F* during the full revolution of the tool, the cutter *H* generating the shape on the short hub of the pad. The pilot on the end of the tool accurately centers it with the work.

Drilling and Tapping Jig

To drill and tap the 3/16-inch hole in the long hub, the pad is held in the jig shown in Fig. 3. Two keys *B* in the base *A* engage a slot in the table

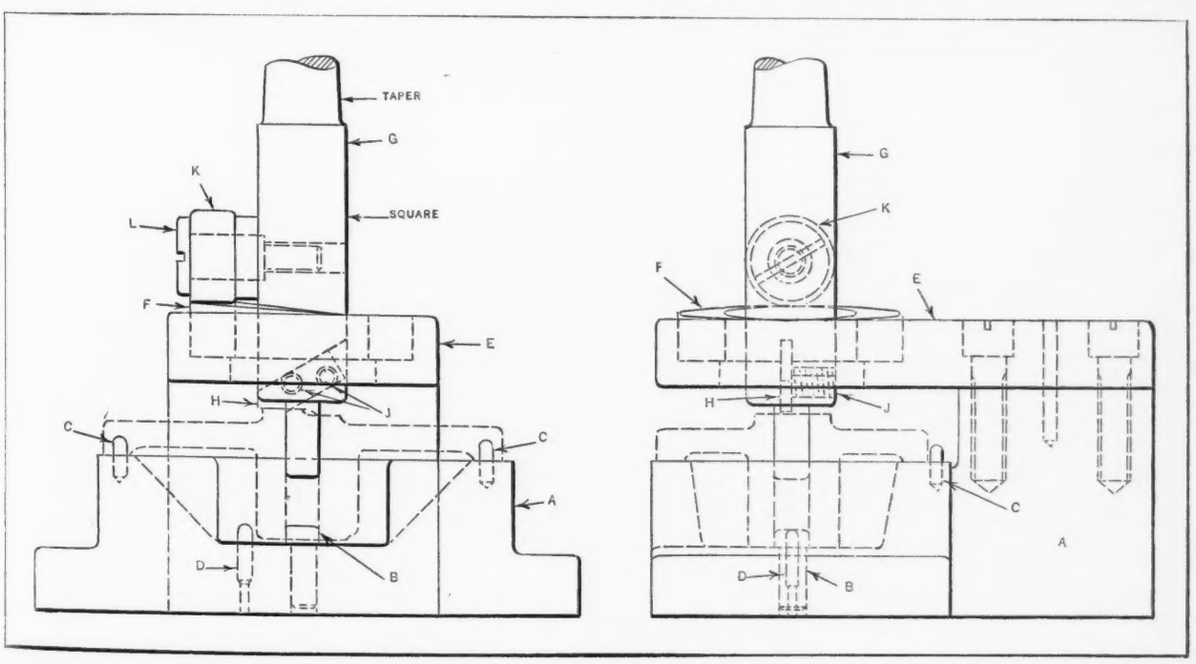


Fig. 2. Jig Used in Machining Cam Surface

of the two-spindle drilling machine, which allows the jig to be moved from one spindle to the other, and at the same time keeps the center of the jig in line with both spindles.

The work is placed in the jig with the previously faced surface of the pad against the under side of the plate *C*, the latter being screwed and doweled to the base *A*. The pad is centralized in the jig by the pin *D* which is a drive fit in the plunger *E*. It is tightened against the plate *C* by the lug *F* of the plunger *E*, which fits against a flat on the cam surface. The plunger is a slide fit in the jig. The spring *G* pushes the plunger away from the work. When the drift pin *H* is withdrawn, the plunger is forced down by the spring to permit reloading.

The drift pin is a slide fit through a slot in the plunger. The bottom of the drift pin slides on a finished surface of the jig, and a stop-pin *J* prevents it from being removed from the jig. Pin *K*, riveted to the outer end of the drift pin serves as a hand-hold for withdrawing the drift pin. It will be noted that two tapers have been provided on the drift pin and on the upper part of the slot in the plunger. The steep taper is for quickly lowering the plunger away from the pad, while the small taper is for locking the plunger when the pad has been positively seated against the plate *C*. Hinged on two lugs on plate *C* is the leaf *L* in which the drill bushing *M* is a press fit. The hinge is provided so that leaf *L* can be swung back out of the way, thus allowing the pad to be tapped in the same jig.

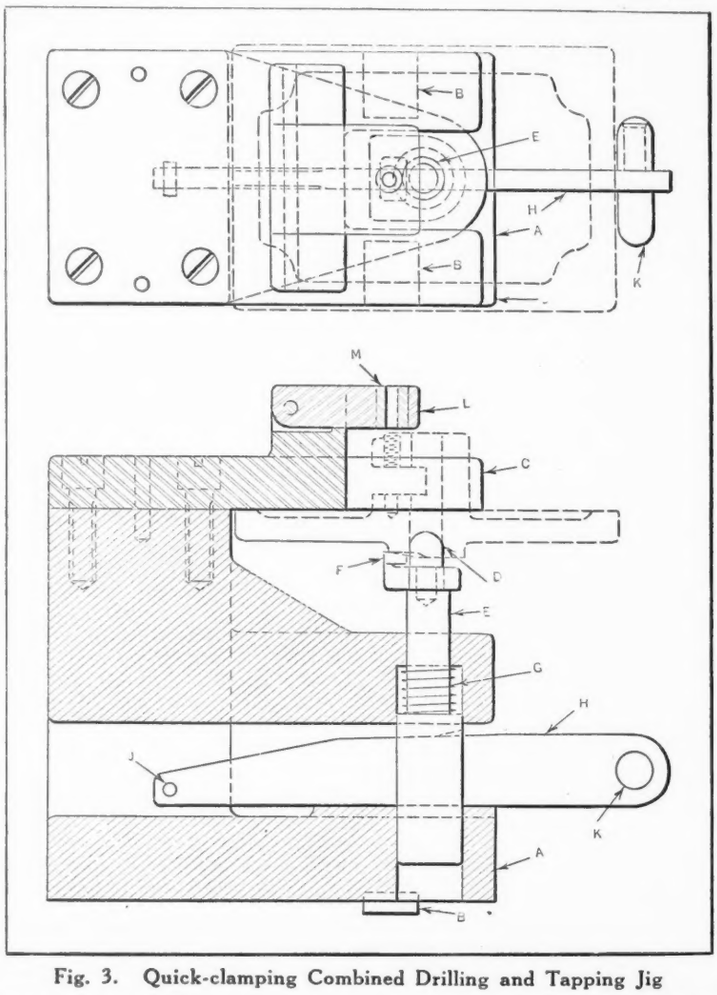


Fig. 3. Quick-clamping Combined Drilling and Tapping Jig

This design of jig can be quickly loaded and unloaded. The drift pin *H* is manipulated with the left hand, the fingers being hooked over the pin *K*, while the loading is done with the right hand.

* * *

Not less than 27,000 employes of the General Electric Co., or 42 per cent, are holders of the General Electric Employes' Securities Corporation bonds, their total holdings being about $30,000,000, or approximately $1100 per person. These bonds pay 6 per cent interest, but so long as the original owner remains in the employ of the General Electric Co., an additional 2 per cent is paid by the company, making the returns to the holder 8 per cent.

NON-CORRODING COPPER ALLOYS

In an article by W. M. Mitchell, recently published in *Industrial and Engineering Chemistry*, it was pointed out that in the attempt to obtain low cost and easy workability, numerous endeavors have been made to improve the corrosion-resisting qualities of copper and its alloys by substituting nickel, either wholly or in part, for the zinc and tin of older brasses and bronzes. "Aterite" is a copper-nickel-iron alloy of variable composition, depending upon the requirements, containing from 10 to 40 per cent nickel, 30 to 60 per cent copper, 5 to 10 per cent iron, and 0 to 5 per cent zinc. Davis metal is of somewhat similar composition, containing less iron, but a small proportion of manganese. "Ambrac" contains 20 per cent nickel, 75 per cent copper, and 5 per cent zinc. "Everbrite" has 30 per cent nickel and the remainder copper; one analysis contains a small proportion of chromium.

These alloys are usually white in color, and therefore are frequently used for household utensils, hardware, hinges, door handles, plumbing fixtures, etc. They can be cast with reasonable facility, are ductile, and may be rolled into sheets, rods, wire, and so on.

"Everdur," is a copper alloy which contains 4 per cent silicon, 1 per cent manganese, and the remainder copper. This alloy, however, is not satisfactory under oxidizing conditions, but affords good resistance to dilute sulphuric acid, copper and zinc sulphates, oxalic and phosphoric acids, etc. This alloy may be cast readily in green sand and may be forged.

* * *

The Italian industrial depression, so strongly in evidence by the latter half of 1926, continued throughout the first half of 1927, with a corresponding decline in machinery imports. This falling tendency was especially marked in imports of machine tools and textile machinery, two of the most important classes. During the first six months of 1927 imports of machine tools totaled 2356 metric tons, or considerably less than half the imports under that head during the corresponding period of 1926.

What MACHINERY'S Readers Think

Brief Contributions of General Interest are Solicited and Paid for

WEAR OF MACHINE TOOL WAYS

The editorial in November MACHINERY "Hardened Steel Ways on Machines" interested me very much. A leading turret lathe builder told me a few weeks ago that nine turret lathes in one plant had been made useless in less than six weeks due to excessive wear of the ways. Perfect alignment of the machines had been insured at great expense, but no provision had been made for wear caused by grit falling down on the ways, and as a result, in high-production work, excessive wear took place.

Lathes and turret lathes as now built are almost the only machine tools in which no adequate provision is made for keeping grit from the guiding surfaces. As lathes are now operated, a great stream of coolant is continually washing mill scale from forgings or sand from castings and fine particles of metal on the ways, and rapid wear results. The protection provided in the form of a wiper of some sort is not sufficient. In view of the great expense to which builders of machine tools go in providing absolutely perfect guiding ways and in fitting the sliding members to them, it would be desirable if means could be provided to protect these ways from abrasive action.

Grinding machines today are generally well protected from grit, and the same principle might be adapted for use on engine and turret lathes. Hardened steel ways reduce the wear, but even then it would be well to protect the ways. I believe that in the future both precision lathes and heavy production turret lathes will be provided with protection for the ways. On bench lathes, too, this improvement is desirable. I recently saw a dozen bench lathes made by a builder of the highest reputation, that in less than a year showed excessive wear of the guiding prism.

A MACHINE TOOL BUILDER

WHAT IS AN EXPERT?

I read with interest the article "What is Expert Advice?" on page 282 of December MACHINERY. It is a subject with which I am familiar from the very nature of my work, and I have drawn specifications for a welding specialist which, if used, would eliminate those "experts" who have a desire to get on somebody's payroll but have no ability to serve. The real specialist tries to save his client time and money. It is usually less expensive to employ accumulated experience temporarily than to attempt to get experience oneself in a hurry, but the employer should take steps to be sure that he deals with a specialist and not a self-appointed expert.

High-grade engineers welcome the real specialist, because he protects them from errors which they might otherwise make. Engineers who really get work done do not hesitate to call in specialists to save time and money. No man can know all about engineering, and it is only the engineer who is afraid of his job that keeps the real specialist out when he is needed.

These are my specifications for employing an electric arc welding specialist:

1. Hire him for one day. Advise the welding foreman, chief engineer, superintendent, and chief executive when he will be present.
2. Have the welding foreman take him out into the welding department and find out if he can weld. A welding specialist who cannot weld as well as the average craftsman may be an expensive engineer to employ.
3. The officials mentioned in (1) should prepare lists of questions on arc welding to ask the arc welding specialist. This will indicate the scope of his knowledge.

ROBERT E. KINKEAD

TRAINING MEN FOR SHOP MANAGEMENT

The article in October MACHINERY "Training Men for Shop Management" interested me because I have found that I can develop shop executives quicker by starting with engineering graduates. There are, however, many difficulties in connection with their training. At one large plant—a leader in its line—men have been obtained in the spring from the engineering schools and set to work in the various departments. They start with energy and ambition, but soon they begin to ask "Where are the men who started last year?"

Last year's men arrived full of the same spirit, but a small percentage only remain. Those who do remain cling to the belief that the conditions under which they are trained cannot long continue—that the management will see that something is wrong and make a change.

What is Your Opinion?

The pages "What MACHINERY's Readers Think" are an open forum. Opinions on subjects of general interest to men engaged in the machine-building and metal-working industries are invited.

One subject dealt with this month is the value of the "outside" expert. Could your shop profit by the outside advice of a qualified engineer who has specialized in some particular mechanical field? How can a firm avoid "hard feeling" among its present shop executives when it calls in the outside expert? These are but a few questions suggested on a subject on which opinions vary widely.

What about shop rules that are too rigid? How can men who refuse to abide by the simple rules necessary for the orderly conduct of a shop be made to change their attitude without using harsh methods?

The course is such that the men spend periods of varying lengths in all the important departments. One great difficulty is that the heads of the departments, on whom the success of the plan really depends, look upon the influx of students as a constant annoyance. They see no advantage to themselves in spending their time training men who will not remain in their departments. They feel that they should not encourage an element in their department which they say is constantly trying to change things so as to make an impression.

The result is that the engineer apprentice finds that he is not wanted and is put on work that is very simple—almost menial—in which he learns nothing. Nothing is expected of him and in his work there arises no contingency in which he can bother the department head with questions. The more ambitious and courageous men have complained, but to complain is to be known as an undesirable. Not receiving any satisfaction and finding themselves in a worse plight for having had the courage to speak, they soon leave, so that from all appearances the company retains only mediocre men. Engineering schools that aid in placing their graduates would do well to make an investigation before they permit companies who give questionable engineering training to employ their best students.

It should be understood that the experience outlined in the foregoing relates to one specific case only, and is not a criticism of the general plan of engineering apprentices, which, when properly handled, gives good results. E. B.

INSTRUCTION FOR INSTRUCTORS

I would like to add a few thoughts to those expressed by John Homewood on page 282 of December MACHINERY. During my education I was taught to believe that a university, trade school, or other institution of learning aimed only to teach the student "how to study"; the longer my experience, the more I appreciate the accuracy of this.

Twenty years' experience in drafting and in teaching drafting in the most varied mechanical fields, and the fact that in the last five years I have learned more about drafting and design in a highly specialized field than I learned in fifteen years previously prompts me to ask the questions: Is it possible to teach drafting or any other subject during the period of time that can be allotted to a boy's education in such a way that he will be equipped to meet all the requirements in the field of his life work? Is it not more probable that if he is taught the fundamentals and at the same time taught "how to study," he may solve the problems he will later encounter, in a more satisfactory manner?

I do not mean to say that it is objectionable for an instructor to be familiar with the methods employed in shops, but even if it were possible for him to be familiar with them all, could he choose the particular practice suited to each student when the student himself does not know what line of engineering he will follow? It follows that the instructor should be rather more academic than less; and that he should stress the fundamental principle of teaching the student "how to study," so that he can qualify himself later for any line of work.

The so-called "practical" man who, in designing, depends wholly upon past experience may continue to make mistakes which he would avoid if he had been taught how to study fundamental principles of engineering rather than to depend merely upon past experience. B. R. SHEETS

WHEN SHOP RULES ARE TOO RIGID

The article entitled "When Shop Rules are Too Rigid," in October MACHINERY, page 117, was read with interest by the writer, who has been foreman in a large engineering establishment for many years. I think that a superintendent should never discharge or even suspend a man simply on the recommendation of a foreman or other member of his staff, but should give the man a hearing in a personal interview. In many cases, the superintendent will find that the recommendations are too severe. He then has the opportunity "to make a good man for the firm." Here is where the great value of mutual understanding comes in.

Violations of established shop rules, however, must never be overlooked. It is especially important not to overlook violations of shop rules in one man and administer strict discipline to another. When a man has just overstepped any of the shop rules, it is better to first censor him—but should he again overstep the rules, there should be no hesitancy in administering the penalty; otherwise the man may have a bad influence on the other men.

It is generally recognized today that "firing and hiring" is an expensive process, as in most instances a newcomer is not worth his wages until he has learned something of the class of work and methods employed in the factory. If, after a trial, the new man is found unsatisfactory, it may be necessary to repeat the "firing and hiring" process.

While it may be possible to obtain workmen having skill in their respective spheres equal to that of the men "fired," it is well for any employer to think of the chaos that would arise if all his workmen, from the manager to the office boy, were replaced on one day's notice by another set of workers, trained in their respective occupations but unfamiliar with the peculiar requirements of his own business. Few employers would like to be in a position of this kind. However, there are many employers who would never realize the value of the knowledge or experience of their trained workers unless confronted by such a condition. A. EYLES

DESTRUCTIVE AND CONSTRUCTIVE CRITICISM

In most shops and drawing-rooms there will be found at least one man who is always ready to find fault with the work of his fellow employes, even though he himself can offer no better method of doing the job. Criticism is desirable only when it is given in a friendly spirit and opens the door for better workmanship by the advancement of practical ideas. The men who constantly criticizes from the mere desire to point out flaws, without suggesting efficient methods of improving the work, soon becomes the most unpopular man about the shop or drawing-room. Everyone despises a "knocker." OLIVER HERBERT

Letters on Practical Subjects

MACHINE FOR SLOTTING ENDS OF FIBER TUBES

The machine shown in the accompanying illustration was designed in response to the demand for increased speed in the slotting operations on fiber pieces like the one shown at *A*. Previous to building the new machine, the slotting operation on the ends of the pieces was performed in a hand milling machine. The new machine consists mainly of the hopper *B*, the feeding dial *C*, and the slotting-saw members. The base *D* of the machine supports the entire mechanism as a unit.

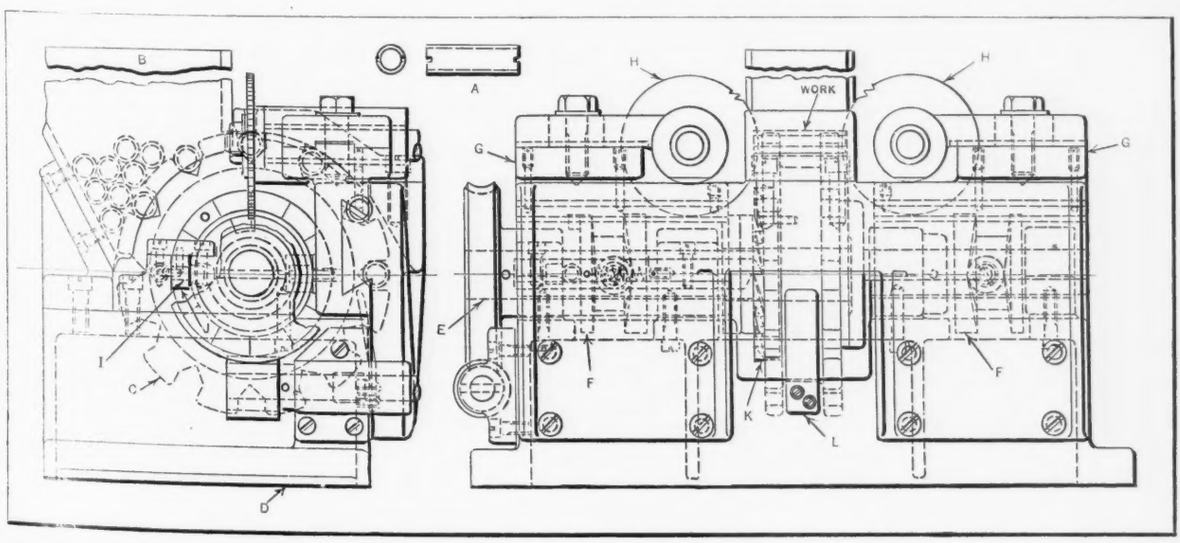
The machine, when in operation, feeds the stacked fiber tubes from the hopper *B* automatically, and it is only necessary for the operator to keep a sufficient supply of tubes in the hopper. The shaft *E*, which rotates continuously, also serves to revolve the cams *F*. Cams *F* feed the slides *G* inward, so that the saws *H* cut the required slots in the ends of the fiber tube held in the feeding dial *C*. On the return movement of the slides *G*, the lug on the cam at the left, acting against the shoulder pin *I*, causes the pawl *J* to release the ratchet *K*. As a result of the frictional contact on both sides of the dial *C*, the latter member revolves, only to be caught or stopped again by the pawl, which engages the next tooth in the ratchet *K*. The saws then advance in the manner previously described, and the cycle of operations is repeated. The slotted tubes are ejected by gravity, assisted by finger *L*.

A sheet-metal guard (not shown in the illustration) is placed over the saws when the machine is in operation. This guard is connected to the exhaust system, and serves to carry away the fiber chips. The machine is lubricated by means of small brass tubes leading to each bearing. The oil system, however, is not shown in the illustration. It might be well to mention here that the installation of the machine described resulted in increasing production approximately 200 per cent.

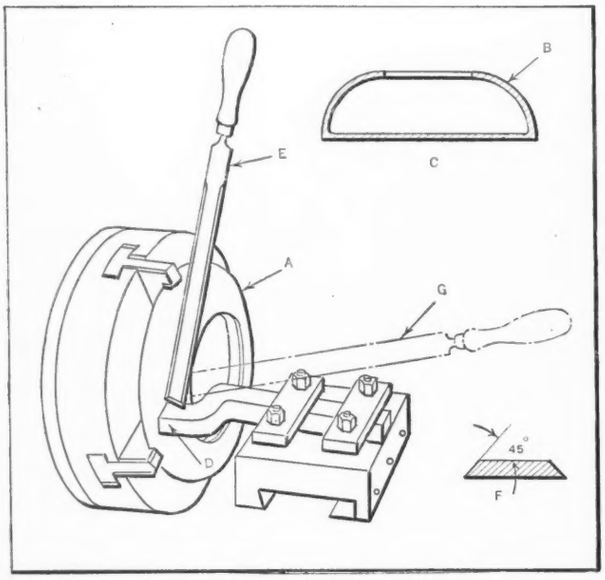
Bridgeport, Conn. J. E. FENNO

FINISHING CAST ALUMINUM SHELLS

Cast aluminum shells like the one shown at *A* in the accompanying illustration are required to have a high polish on the curved portion, although the accuracy of the outline for contour is not important. The edge of the opening and the corner at the bottom are required to be trimmed smooth. The original method of finishing was to cut down the sandy surface with stitched mops and abrasive. This method was tried with and without pickling the castings. However, the cost of finishing by this method was too high, owing to the short life of the prepared surfaces of the mops, glazing of the cutting face, and the difficulty experienced in removing scratches produced during the rough-grinding operation. Rotary wire brushes were also tried out, and although they produced a fine satin finish, they did not cut deep enough to eliminate surface pin-holes in many of the castings.



Machine for Slotting Ends of Fiber Tubes



Method of Finishing Aluminum Castings

The quantity of parts made did not warrant the expense of special equipment for turning the curved portion *B* shown by the cross-section view at *C*. The contour of the curved portion is such that it cannot be turned by a simple radius turning device. Hand-turning to remove the scale before buffing was next tried. The conventional form of hand-turning tool was tried first, but when given sufficient top rake to obtain a clean cut, trouble was experienced. The chips became welded to the tool point, and it was difficult to prevent the tool from digging into the soft aluminum when irregularities of contour or hard spots were encountered.

A very satisfactory method of giving the work a machined finish, which could be polished with a soft mop and polishing compound to present a brilliant surface, is shown in the illustration. The aluminum shells are about 7 inches in diameter and 2 inches high. The first operation was to finish the flat portion of the profile near the base for a height of about 3/4 inch. For performing this operation, the shell was held in a self-centering chuck inserted through the central hole. The curved bar *D*, clamped in the tool-rest, served as a support for the cutting tool for both operations.

The casting was next gripped as shown in the illustration, and the cut taken on the curved surface in a single sweep of the tool, beginning near the chuck jaws and overlapping the portion already finished. The position of the tool *E*, when finishing the curved portion, is indicated in the illustration. It will be noted that the lower end of the tool is supported by the bar *D*. When the tool is made from a 12-inch flat file, the length projecting beyond the point of contact with the work is sufficient to give a good leverage.

The edges of the flat files used for skimming or finishing the castings were ground down to an angle of 45 degrees, as indicated in view *F*. The teeth were also ground off the wider face a few inches back from the point. Several of these tools were kept on hand, and when dull, it was a simple matter for the operator to regrind them. The end of the tool was also ground at a bevel, in order to give a fairly sharp corner that would bite into the forged supporting bar *D* and prevent the tool from slipping and injuring the work or the operator.

In applying the file in the manner shown, a draw-cut shearing effect was obtained which could be easily controlled by the workman. The dotted lines at *G* show the tool, as held when finishing the edge of the opening. The work was rotated at a speed of about 300 revolutions per minute. Soapy water, which was allowed to drip on the work, proved to be an inexpensive but efficient lubricant.

Cooperation by the foundry in regulating the pouring temperatures of the metal when casting the shells proved of great help, as it resulted in producing castings of a uniformly soft nature. Some idea of the strength of the aluminum castings is indicated by the fact that they could not be broken by means of a hand maul. It was found necessary to resort to the use of a power hammer in order to break up some of the old spoiled castings. The average thickness of the shell in the rough was 5/32 inch.

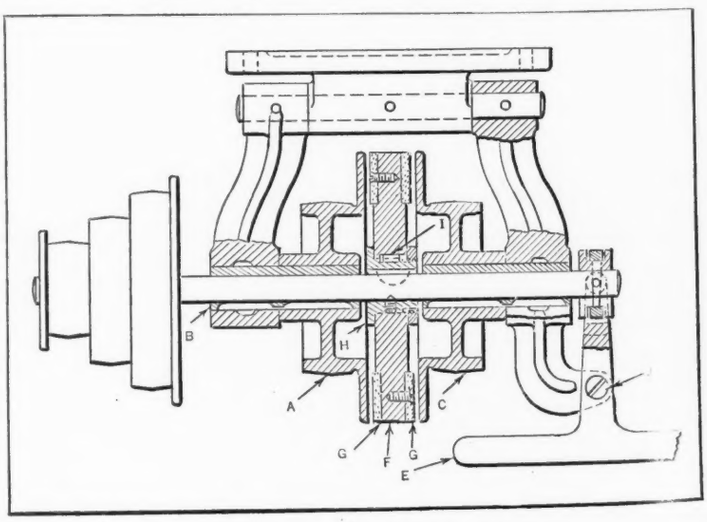
Auburn, N. Y. WALTER S. BROWN

FRICTION COUNTERSHAFT FOR BENCH LATHE

The friction countershaft shown in the accompanying illustration is used for driving bench lathes employed in the manufacture of small brass parts for precision instruments. This type of countershaft is cheaper to construct than the clutch type.

Referring to the illustration, *A* is a loose pulley which runs on bushing *B* at a speed of about 300 revolutions per minute, being driven from the lineshaft. At *C* is another loose pulley, which runs at a speed of about 600 revolutions per minute and which is also driven from the lineshaft. The speed change is controlled by shifting lever *E* which may be operated by a foot-treadle.

By shifting lever *E* on the fulcrum screw *J* either to the right or left, the friction pads *G* on the drum *F* will be brought into contact with either pulley *A* or pulley *C*, thus producing an instant change in speed. The friction drum *F* is secured



Countershaft for Bench Lathe

to the bushing *H* by pin *I* and is keyed to the shaft. Oil-cups are provided on the pulleys for conducting oil to the shaft and ball bearings through the oil channels shown in the cross-section view.

Rochester, N. Y. EDWARD T. HEARD

LATHE ATTACHMENT FOR TURNING RIM OF CONCAVE-CONVEX SHAPE

An interesting lathe attachment for performing an unusual turning operation is shown in the accompanying illustration. The work consists of finishing the rim of the brass casting shown at *A*. This casting is part of a clapper valve arrangement used in a large water measuring device. The valve functions to shut off the water flow when the pressure of the water falls below a predetermined point.

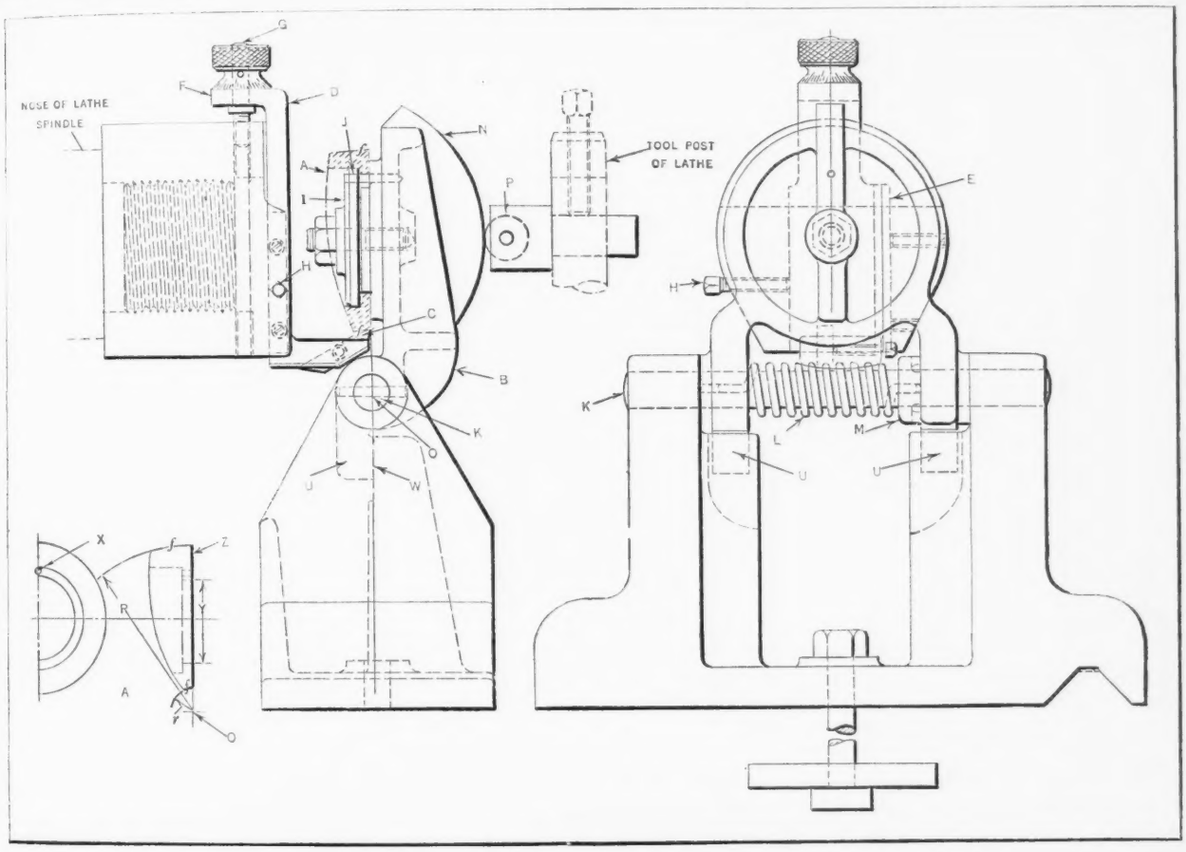
The casting is fastened to the clapper valve and swings with the valve, its particular purpose being to effect a perfect seat or seal that will prevent water leakage. It accomplishes this by entering the flow pipe ahead of the valve seat, sealing the pipe against leakage by the contact of its rim with the inner wall of the pipe. The concave-convex shape of the rim machined by the use of the fixture to be described is necessary in order to permit the rim to enter the pipe with a swinging or pivoting motion about the point *O*.

The face *Z* of the casting is machined on a turret lathe so that it is in the same plane as center *O*. The hole having a diameter *Y* is also machined at the same setting. The drilling of the small hole *X* completes the machining operations on the casting previous to the rim-turning operation. The requirements of the attachment are that the casting be held securely on the member *B*, which is swung about point *O* while the tool *C*, in a holder mounted on the spindle, turns the rim of the casting, as indicated by the finish marks. This arrangement results in turning the rim to a concave-convex shape. At the side nearest point *O* the rim is concave, being formed to radius *r*, while at the farthest point from *O* the rim has a convex shape conforming to the radius *R*.

At the front of the adapter which is screwed on the end of the lathe spindle is a slot with angular sides in which the slide *D* is carefully fitted. This slide is adjusted in the usual manner by means of set-screws at the back of gib *E*. Slide *D* has two projections; the upper one at *F*, projecting back over the adapter, contains the adjusting screw *G* which is screwed into a tapped hole in the adapter.

A graduated dial, pinned to screw *G*, provides a means for close adjustment of the turning tool *C* held in the slide *D*. The turning tool fits a slot cut at an angle in the lower projection on slide *D*. When the tool is set in the proper position, slide *D* is clamped in place by the screw *H*. The turning tool is clamped in its slot by means of a set-screw, as shown.

The casting *A* to be turned is located by means of a boss on part *B*, which is a close fit in the finished bore *Y* in the casting. A washer *I* is used to clamp the work in place in the manner indicated. The work is located in the proper position by the pin *J* which enters the previously drilled hole. The work-holding member *B* pivots about the pin *K*, which is a drive fit in the frame casting secured to the ways of the lathe.



Lathe Attachment for Turning Rim of Concave-Convex Shape

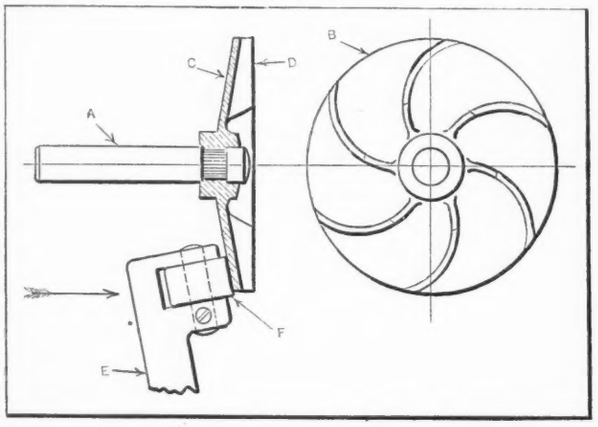
A torsion spring *L*, wound about pin *K*, is so adjusted by the collar *M* that it keeps the surface *N* of the rib at the back of member *B* in contact with the roller *P* mounted in a holder held in the toolpost of the lathe. When the cross-slide is moved to the right, the member *B* pivots about pin *K* in a clockwise direction until it has reached a position in which the work can be clamped in place.

After the work is clamped, the cross-slide is fed to the left, causing the roller *P* to press against the work-holding member *B* and rotate about center *O* in a counter-clockwise direction against the action of spring *L*. As the toolpost is fed toward the spindle by means of the cross-slide carriage handle on the apron of the lathe, the work is brought in contact with the revolving turning tool *C*. The feeding movement of the toolpost is continued until the holder *B* is in the upright position, as shown in the illustration, and the projecting ends *U* of member *B* are in contact with the stop surfaces at *W*. This completes the turning of the concave-convex rim of the casting.

New York City — B. J. STERN

STRAIGHTENING PUMP ROTOR CAST ON SHAFT

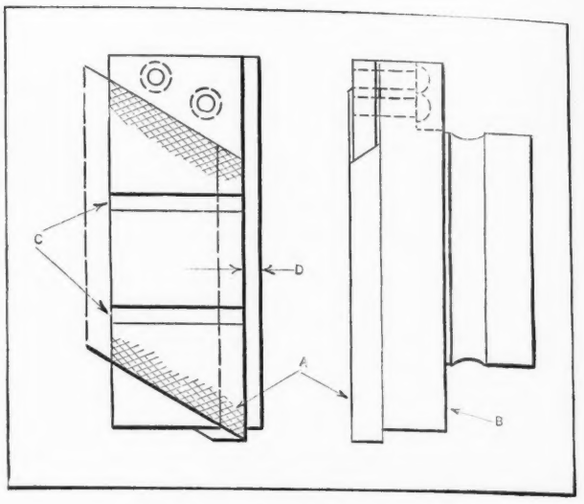
The pump impeller shown in the accompanying illustration is composed of a steel shaft *A* and the rotor *B*, which is die-cast on the shaft. It is necessary that the front and back faces *C* and *D* of the rotor run true with respect to the center line of the shaft, because of the close fit between this member and the pump housing. A large percentage of the rotors were found to run out of true when received from the maker, due to warpage when cooling or careless handling during shipment.



Method of Straightening Pump Rotor

The method used in straightening the parts may be of interest to others who encounter similar difficulties. The impeller shaft *A* is gripped in the spring collet of a lathe, and the spinning tool *E*, held in the toolpost, is fed in the direction indicated by the arrow. This forces the hardened roller *F* against the face *C* of the rotor. Only a few revolutions of the work are required to straighten the rotor. Although the equipment used in straightening the rotor is very simple, the speed at which the work is handled and the accurate alignment obtained have proved it to be efficient.

Syracuse, N. Y. — ELMER C. COOLEY



Tool for Finishing Metal Patterns

FINISHING TOOL FOR METAL PATTERNMAKERS

After considerable experimenting, the device shown in the illustration was developed for use in finishing inaccessible parts of metal patterns. The tool is used in places where a riffle and scraper are ordinarily employed. It consists of a short piece of double-cut file *A*, with the ends cut at an angle as shown, and a block *B* for holding the file so that it can be adjusted laterally. Chip grooves are cut or ground in the face of block *B* at *C*.

In finishing a metal pattern, the fillets can be smoothed off first with a round riffle or file, after which the device shown can be used to finish the part adjacent to the fillet. The file can be so adjusted that it will not ride up on or scar the fillet. In cases where the surfaces adjacent to the fillet are flat or convex, the distance *D* is made the same as the radius of the fillet. The overhanging edge of the holder effectively guards against a false movement of the tool. The overhanging pointed end of the tool can be used to finish parts of the work not readily accessible.

Willimantic, Conn. — HERBERT A. FREEMAN

HOOKS FOR LIFTING LOCOMOTIVE TIRES

Tire hooks that are especially useful for lifting locomotive driving wheel tires on or off the boring mill table are shown in use in Fig. 1 and in detail in Fig. 2. These hooks are so designed that a tire

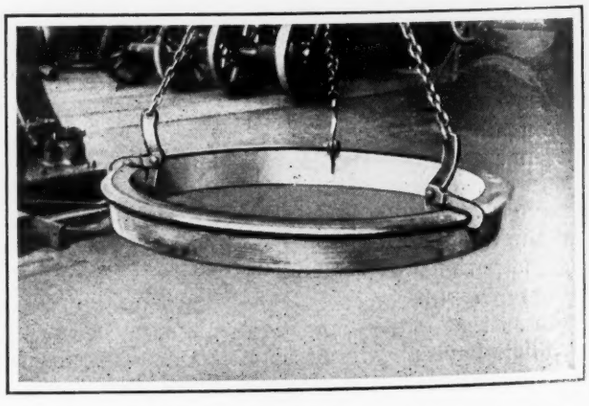


Fig. 1. Method of Using Hooks in Lifting a Tire from the Floor

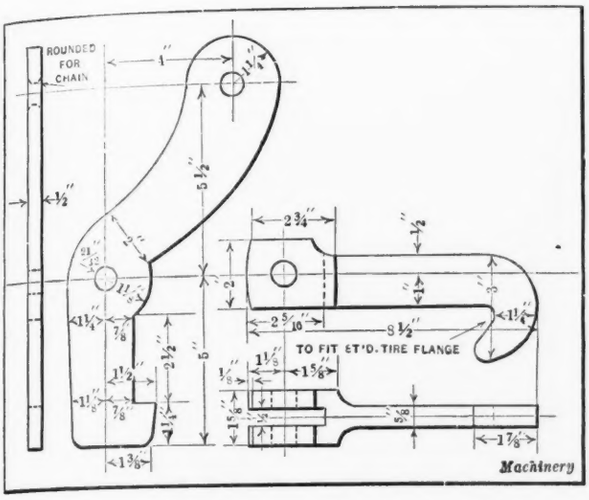


Fig. 2. Two Parts that Form Style of Hook Illustrated in Fig. 1

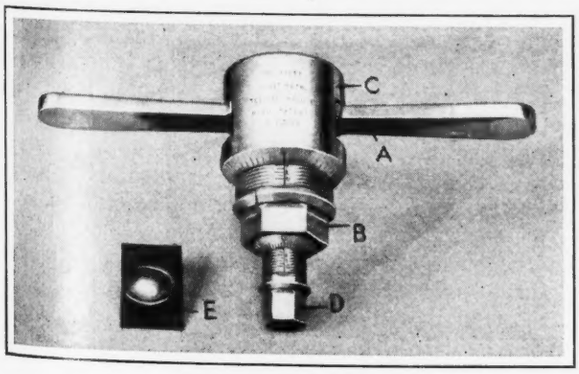
can be gripped securely from the flange side, and they release automatically as soon as the lifting chains are slackened. Fig. 1 shows a sling having three hooks, but two, placed on opposite sides of the tire, may be used if desired. With these lifting hooks and some type of hoist, one man can easily lift a tire either from the floor or from the top of a pile of tires.

San Bernardino, Cal. J. R. PHELPS

DEVICE FOR TESTING DUCTILITY OF SHEET METAL

Ductility, malleability, and tenacity are the most important requirements of sheet metals. A metal that is ductile may be easily hammered to shape, readily yields to pressure, and at the same time is tenacious. In other words, a metal in order to be ductile, must be both tenacious and malleable. It must be tenacious to resist being broken or torn apart and malleable to allow its atoms to flow and take up new positions under strain. Ductility is an essential property of sheet metal used in the automotive and general engineering industries.

The device shown in the accompanying illustration was recently developed by W. & T. Avery Ltd., Birmingham, England, for testing the relative ductility of sheet metal by distention. It is of a portable nature, and is designed especially for shop use. A narrow strip of the sheet metal to be tested is inserted between the upper and lower members of the device through the opening at *A*. To determine the thickness of the metal, the lower clamping member *B* is held stationary by inserting the hexagonal end of the large plunger in a socket let into the work-bench. The outer member *C* is then rotated by means of the flat handle at the top until the specimen is tightly gripped between the two clamping members. A reading of the graduations marked upon the beveled edge of the outer member is then taken in conjunction with a reading of the graduations on the screw. From the readings thus obtained the thickness of the metal is determined.



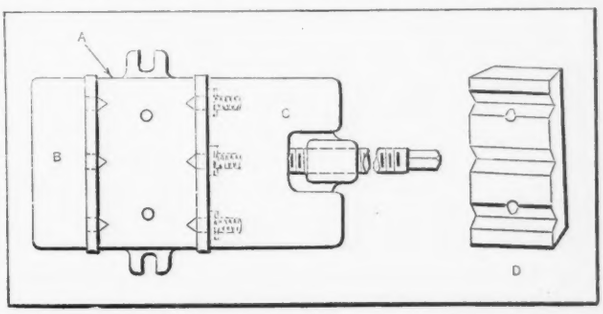
Testing Device for Determining Ductility of Sheet Metal

To test the ductility of the sheet metal, the hexagonal portion of the small plunger *D* is inserted in a second socket in the work-bench, and the flat handle again rotated until a dome-shaped bulge is produced in the piece under test by the hardened steel ball inside the apparatus. The height of the bulge before fracture occurs, as in the case of the sample shown at *E*, is a measure of the ductility of the sheet metal and can be recorded by reading the graduations on the beveled edge of the large plunger in conjunction with the reading of the graduations on the screw *D*. The simplicity and portability of the apparatus makes it well suited for inspection purposes.

Manchester, England A. EYLES

TRIPLE CENTER CLAMPING VISE FOR KEYWAY MILLING

In the accompanying illustration, is shown a vise used in milling keyseats on shafts for small embossing presses. These presses are made up in lots of 100 every six months, and consequently pro-



Vise for Holding Three Short Shafts while Milling Keyways

duction jigs and fixtures are not considered necessary. The keyseats were cut in the short shafts one at a time, using a standard indexing center to hold the shaft on the milling machine. As this method seemed too slow, the writer equipped the machine vise shown in the accompanying illustration with three pairs of centers so that keyways could be milled in three shafts at one time.

Referring to the illustration, *A* is a standard machine vise with the usual jaws *B* and *C*. Three hardened cones or centers were fitted to each jaw as shown, the centers attached to jaw *B* being fixed, while those in jaw *C* were made a sliding fit in counterbored holes and backed up by short powerful springs as indicated. The latter centers are thus permitted to move a sufficient amount under the clamping pressure to take care of any slight variations in the lengths of the shafts or in the depths of the center drilling. This or a similar feature is essential for the successful operation of the device.

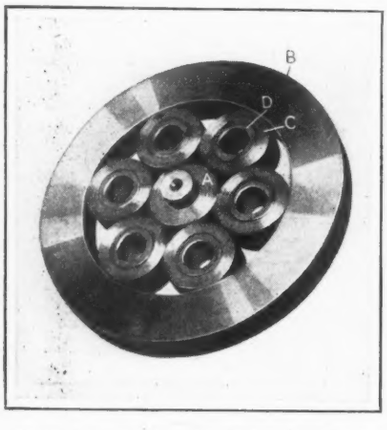
As it was impossible for one operator to hold three shafts in line with the centers and tighten the vise jaws at the same time, a work cradle, as shown at *D*, was made up for locating the shafts approximately. This holder consists of a rectangular casting with three V-grooves milled across one side and two drilled and tapped holes for securing it between the jaws of the vise. With this improved clamping vise, three shafts were keyseated in the time required to cut the keyway in one shaft by the old method.

London, England — ROBERT JULIAN

NOVEL DRILL JIG FOR SPACING HOLES ON CIRCLE

The jig shown in the accompanying illustration for use in drilling six evenly spaced holes on a 2 1/8-inch circle, was developed in an emergency at the plant of the Alling-Lander Co., Inc., Sodus, N. Y., when the only machine tool available at the time for its production was a lathe. The calculations necessary for a jig of this kind are very simple, especially when an even number of holes is required. In this case, the six spacing rings *C*, each of which holds a regular hardened and ground bushing *D*, is 1 1/16 inches in diameter, as is also the center plug *A*.

The bore of the large ring *B* is 3 3/16 inches. The spacing rings and the center plug should be about 0.0005 inch over the nominal size, while the inside diameter of the outer ring should be about 0.0005 inch less than the nominal size, so that the assembly can be pressed firmly together.



Drill Jig for Spacing Holes on Circle

The calculations required in constructing a similar jig having an odd number of holes may be obtained by means of the formula for circular segments on page 132 of the fifth edition of MACHINERY'S HANDBOOK (page 153 of the sixth edition). After the circumference of the desired circle has been divided by the number of spaces, the value of *C* will equal the diameter of the rings which hold the hardened bushings.

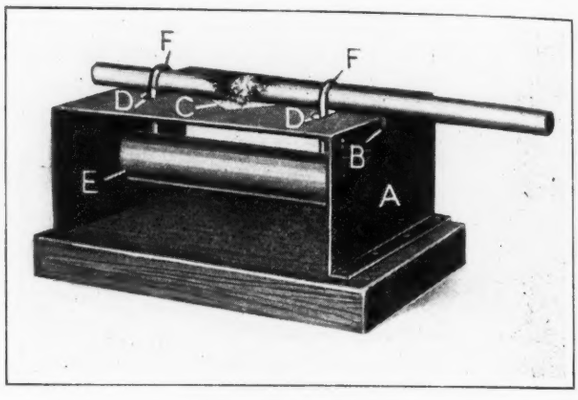
The same calculation can be used to find the diameter of the outer ring and the central plug. The writer is not certain that he is the originator of the type of jig illustrated and described, but he has never seen or heard of one being constructed in the same manner. The spacing obtained with the jig is very accurate.

Sodus, N. Y. — W. H. LANDER

BUTT-WELDING FIXTURE

To weld two pieces end to end by the acetylene process, they may be laid on a table without clamping; but usually considerable straightening has to be done afterward. Tight clamping is not desirable either, but a light clamping effect is necessary to hold the parts in line at the beginning of the welding operation.

A repair shop, doing a considerable business in welding of this kind, made an inexpensive fixture for holding light work, which produced good results. A piece of heavy gage sheet steel *A* was bent to shape and fastened to a base block, as shown in the accompanying illustration. A slot *B*



Butt-welding Fixture

was cut along the top to hold the work in line, and a diamond-shaped hole *C* was cut in the center to provide clearance for the torch flame. Two small slots *D* at right angles to slot *B* were cut at a suitable distance each side of the center hole. A round piece of stock *E* was tapped for two eye screws, as shown.

The parts to be welded together are slipped through the screw eyes, and the weight of the round stock holds them down in the aligning slot. This type of clamp operates from beneath the work and thereby eliminates obstructions on top. Only light work which requires a small torch tip can be held in a fixture made of sheet steel, but the same principle can be employed in constructing a fixture for heavier work.

Hamilton, Ont., Can. — ARTHUR KENDALL

* * *

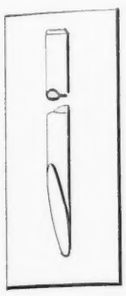
THE PROGRESS OF AVIATION

During 1927, approximately 3000 airplanes were built in the United States. At the end of the year there were 4500 miles of airways properly lighted. The work of lighting 2500 additional miles of airways is progressing, and Congress will be asked to appropriate funds for the lighting of still another 2500 miles. At the present time, 15,000 miles are flown every day in the carrying of mails throughout the United States, and within another six months this will be extended to 20,000 miles a day, which will be equal to the mileage flown on all the airways of Europe. There are altogether 25 air mail routes now operating or immediately ready for operation. These will serve 79 air stations and cover a territory having practically one-half the population of the United States. The total length of these air routes is 12,000 miles. As it is estimated that private operators fly at least an equivalent mileage to that flown by air mail pilots, it is estimated that at the present time 30,000 or more miles a day are covered by airplanes.

Shop and Drafting-room Kinks

REAMERS MADE FROM DRILL ROD

A full line or stock of small reamers is seldom found in the average tool-room. Nevertheless, reamers of small size are frequently needed for such work as finishing jig bushings. The makeshift method of drilling the hole with a drill one size smaller than the size of hole required and then employing a twist drill of the desired size as a reamer is often used. The type of reamer shown in the illustration gives a very smooth hole, and one that is round and true to size within reasonable limits. It consists simply of a piece of drill rod of the required size, hardened and ground on the end at an angle of 15 degrees.

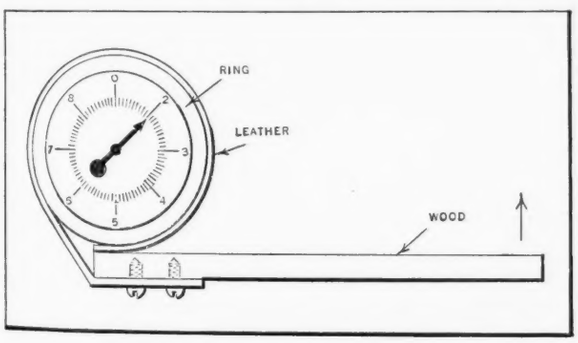


Reamer Made from Drill Rod

Riverside, Ill. F. MARTINDELL

REMOVING THREADED RING

The method of removing glass gage rings described in November MACHINERY, page 225, brings to mind a method that the writer has used with success. The device employed, as shown in the accompanying illustration, consists of a leather strap, approximately 1/2 by 1/16 inch, secured to the end of a wood stick or handle. By wrapping the strap around the instrument as shown and pulling on the handle, a good grip on the ring to be removed will be obtained. This device will not scar the instrument, is inexpensive to make, and will fit instruments of various sizes.



Device for Removing Threaded Ring

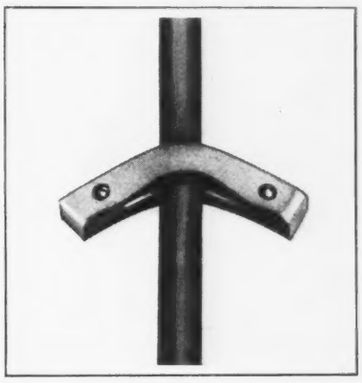
Brooklawn, N. J. JOHN W. GARDINER

The writer noted with considerable interest the suggestion for using an old inner tube to facilitate the removal of gage glasses, on page 225 of November MACHINERY. The method is a feasible one, but in many instances it will not be necessary to resort to this expedient if, instead of gripping the large gage ring with the fingers, the full hand is used. This is done by placing the palm of the hand across the full face of the glass, not using the fingers at all, and then giving the glass a turning motion in the proper direction, exerting full pressure against the surface of the glass. The larger friction area thus provided will make it relatively easy to move the ring.

Philadelphia, Pa. E. L. FAIRALL

PREVENTING VIBRATION IN SMALL PIPE LINES

Short pieces of rubber cut from a strip or coil of old hardened water pump packing make good supports for small metal tube or pipe lines. The pieces of packing are slit and forced over the pipe before coupling, and are then nailed in place as shown in the illustration. This method, originally devised for securing tubing for a gage to the wood portions of a crane housing, proved convenient and inexpensive. It also eliminated the rattle and vibration usually found in small temporary pipe lines nailed or clamped in place in the usual way.



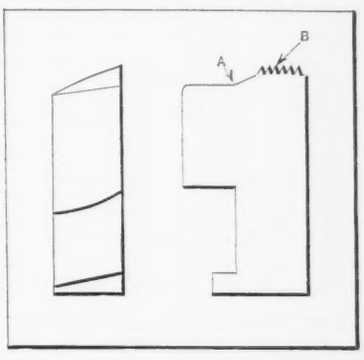
Rubber Fastening for Pipe Line

Missouri Valley, Iowa F. W. BENTLEY, JR.

INCREASING THE LIFE OF A BOLT MACHINE THREADING DIE

The first two or three teeth of the threading die of a bolt machine stand practically all the strain in cutting threads on bolts, rods, etc., and are therefore worn down before the rear teeth are affected. When the first teeth become worn, the threads on the work are often stripped, causing waste of material. In most cases, the dies are scrapped, and new ones obtained. If they were properly ground, however, many of the scrapped dies would give efficient service for a considerable length of time.

The accompanying illustration shows a die in which the worn teeth have been ground away at *A* so that the teeth at *B*, which have not been affected by wear, will be presented to the work. Dies ground in this manner will give good service, and will reduce the expense for new dies.



Bolt-threading Die with Worn Teeth Ground Away

R. L. WALLACE
South Norfolk, Va.

Questions and Answers

WORKMEN'S COMPENSATION

J. W. H.—Is an employer liable for damages as a result of injuries sustained by an employe due to the action of an incompetent fellow workman? What is "incompetency" in a workman?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

In a quite recently decided controversy, an employer was held liable for the death of a workman caused by the incompetency of a fellow-workman, who unintentionally turned on the power while his fellow-employe was cleaning a dangerous mechanism. The Court said that incompetency of a workman is by no means confined to his inability to do properly the particular work required.

In another case, the Court said that a competent man is one who may be relied upon to execute the duties required of him by his employer. Therefore, incompetency does not merely refer to a man who is inexperienced in the performance of his various duties, as it may include physical handicap, mental weakness, and the like, as well as insufficiency of practical experience. Moreover, incompetency may arise from lack of practice for a long period.

To avoid the risk of liability from this source, it is necessary for an employer to use reasonable care and diligence in engaging, hiring, or employing reasonably careful workmen. Furthermore, the employer must consider the danger of the work to be performed, so that other employes will not, in the regular course of their employment, be exposed to undue and unnecessary risks from the negligence and carelessness of an incompetent workman.

It has been held that the age of an employe is an important factor in determining whether or not he is competent to perform the work he is required to do. On the other hand, a workman may be of the proper age, but he may be incompetent because he is intemperate in some manner that affects his ability to do the particular work he is hired to perform. A Court recently held that a habitual drinker, seldom free from the influence of liquor, is not competent to work with and operate dangerous machinery. This is true because dangerous work requires a man of steady nerves, caution, and quick thought. Therefore, incompetency of a workman may be the result of inexperience, physical condition, intemperance, youth or old age, or not being in practice.

Where an employe was injured because the operator of a power plant control was too deaf to hear a danger signal whistle, the Court held that a person who is so deaf that he cannot hear danger signals is incompetent for work which involves the duties of starting and stopping machinery on such signals. The employer was therefore held liable.

However, recently a Court decided that the mere fact that a person has poor eyesight will not necessarily unfit him for work, if he utilizes the proper glasses to enable him to see reasonably accurately.

Numerous litigations have resulted where employes are injured by the unintentional acts of fellow-employes who are unable to understand the English language. For instance, in the case where a foreigner started a machine when told not to do so, with the result that it cut off the fingers of another person who was working on the same machine, the Court held the employer liable for the injuries sustained by the workman. The Court explained that the incompetency of an employe varies with the nature of the duties he is called upon to perform, and that where mere manual labor is being performed, the matter of language would not be of importance, but it is improper for an employer to place a workman who cannot speak English in the midst of other workmen when the character of the work is dangerous.

As a matter of law, if a workman does something improperly that is likely to result in great damage, the doing of this single act may be sufficient to justify a Court in holding that he is incompetent.

CUTTING LUBRICANTS

A. T. L.—In cutting tool steel at high speed, what proportion of red oil (oleic acid) is used in the cutting mixture? Are there any special advantages in using red oil? Is it non-viscous? Does it aid in the emulsification of grease? If so, does it have an advantage over other oils used for this purpose? Is red oil especially desirable because it rapidly transmits heat from the point of contact, and, in addition, serves as a good lubricant?

This question is submitted to MACHINERY'S readers.

COST OF OBTAINING PATENT

C. F.—What is the approximate cost of obtaining a patent?

A.—The cost of obtaining a patent consists of the fee paid to the Government and the fee paid to the patent attorney who prepares the patent application and takes care of the necessary procedure for obtaining the patent. It would not be possible to state, even approximately, how much this fee would be, as it would vary according to the amount of work to be done in connection with the patent application and other conditions. The government fee is fixed, however, and amounts to $20 with the filing of the application and $20 after the patent is allowed. In addition, there is a charge of $1 for each claim, over twenty claims, when the application is filed, and an additional $1 for each claim, over twenty, when the patent is allowed.

* * *

Experiments with bamboo for the making of paper have reached such a stage in India that the government is planning to build a factory large enough to try out the process on a commercial scale.

Fig. 1. Airplane View of the Leipzig Exhibition Buildings. The Large Structure to the Extreme Right is the Machine Tool Building

THE COMING LEIPZIG FAIR

The fair to be held from March 4 to 10 at Leipzig, Germany, will include 1200 exhibits of machinery of all kinds, a very large proportion of which will be machine tools. In all, there will be 10,000 exhibits of industrial products from more than twenty countries. Basing the estimate upon the attendance in past years, it is believed that fully 250,000 people will visit the fair.

The Leipzig Fair has tripled in size and attendance since the end of the war. A great number of exhibition buildings have been added, and a new hall, twice the size of Madison Square Garden, has been built to house the automobile exhibition. Further information may be obtained from the Leipzig Trade Fair, Inc., 630 Fifth Ave., New York City.

* * *

NICKEL IN CAST IRON IMPROVES QUALITY

According to the results of experiments conducted at the Bayonne laboratory of the International Nickel Co., 67 Wall St., New York City, the use of nickel in cast iron produces substantially the same improvements as in steel. By the use of nickel, or nickel and chromium, in cast iron, the following improvements are stated to be obtained: Increased strength; greater toughness; uniformly increased hardness with better machineability; reduction in chill; and increased wear resistance.

S. A. E. ANNUAL MEETING

The annual meeting of the Society of Automotive Engineers was held at the Book-Cadillac Hotel, Detroit, Mich., January 24 to 27. Twenty-six different papers were presented covering many phases of automobile engineering. Some were of particular interest to specialists in automobile design, while others dealt with broader subjects of interest to anyone in the mechanical field.

Among the latter may be mentioned "High-speed Automotive Diesel Engines," by Dr. Riehm of Maschinen-Fabrik Augsburg, Nurenburg, Germany; "Results of Recent American Development Work on High-speed Diesel Engines," by R. J. Broege, of the Buda Co., St. Louis, Mo.; "The Development of the Maybach High-speed Diesel Engine," by F. W. Von Meister of the Maybach Motor Co.; "The Rail-car High-speed Diesel Engine," by O. D. Treiber of the Treiber Diesel Engine Corporation; "Industrial Engines," by H. L. Horning of the Waukesha Motor Co.; "Application of High-speed Motion Pictures to Engineering Development," by C. Francis Jenkins of the Jenkins Laboratories; "New Developments in Aluminum Alloy Pistons," by H. A. Huebotter of the Butler Mfg. Co.; "The Future of Aeronautics," by A. H. G. Fokker of the Fokker Aircraft Corporation; "Research on the Hardness and Machineability of Cast Iron," by T. H. Wickenden of the International Nickel Co.

Fig. 2. A View in the Machine Tool Building of the Leipzig Fair

Madison-Kipp Die-Casting Machine

As a manufacturer of automatic pressure lubricators, the Madison-Kipp Corporation, Madison, Wis., uses large quantities of die-castings. The advantages of manufacturing these parts in the company's own plant became apparent, and as there was no suitable die-casting machine on the market, the company's engineers undertook the design of equipment for the purpose. The first machine was placed in operation in 1920 and was rapidly developed to a point of high efficiency, judged both from rates of output and quality of product.

Realizing the existence of a demand for machines that would enable manufacturers in other lines to produce their own die-castings, the company has gone a step further by developing machines adapted to the production of die-castings covering a wide range of sizes and forms, and several of these have already been placed in service with outside firms and have given very satisfactory results.

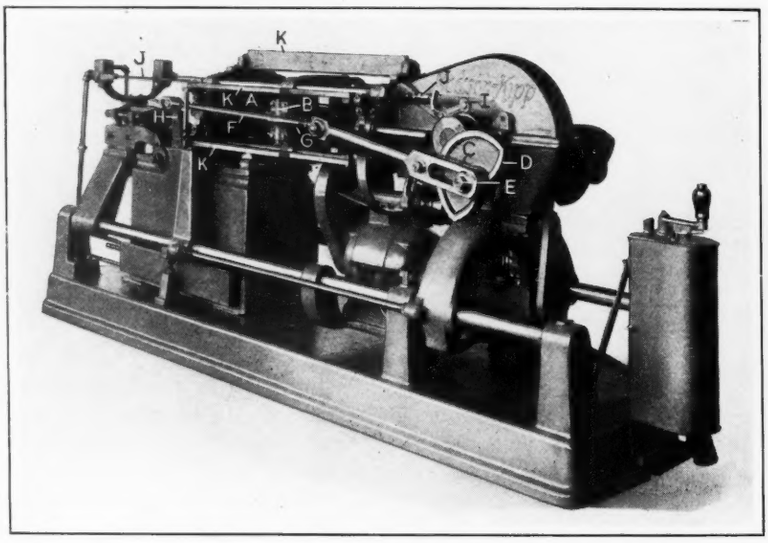


Fig. 1. Automatic Die-casting Machine Brought Out by the Madison-Kipp Corporation

Many companies using die-castings in their product might feel reluctant to develop tool-room facilities for designing and making dies. To meet this requirement, the Madison-Kipp Corporation has added a fully equipped tool-room capable of making dies suitable for the requirements of any customer. A number of dies have already been made for complicated jobs, one of which involved provisions for manipulating thirty-one cores in eleven directions.

The die-casting machine is of the air-operated, gooseneck type. All movements in the machine cycle, and of the die are governed by a single lever, which engages the driving clutch. All subsequent movements of the machine and die are fully automatic. The machine can be stopped and reversed at any point, should some abnormal condition make this desirable. Standard zinc-base or aluminum-base metals obtainable from commercial sources are used in the machine. It can be operated by average factory labor as the attendant merely watches the ejection of castings from the die and cleans the die with an air blast at suitable intervals.

Mechanical Features of the Machine

The machine is driven by a special Fairbanks-Morse variable-speed motor which may be regulated for operating at four, six, eight, or twelve "shots" per minute. From this motor the drive is through back-gears and thence to a worm and worm-wheel, which drive a mechanism that affords an intermittent motion for advancing the die carriage to close the die and leaving it in this position while an elevating mechanism raises the gooseneck into place to deliver its "shot" of molten metal, allowing sufficient time for the metal to solidify before the die is opened and the finished casting ejected.

From Fig. 1 it will be seen that the fixed half of the die is carried on a hot plate *A*, while the moving half of the die is mounted on the reciprocating carriage *B*. This carriage receives an intermittent motion from the mechanism previously mentioned, which consists of a slotted link *C* and an eccentrically mounted cam *D* that engages a roller mounted on the inside of link *C*. With the machine in the position shown, that is, with the die open, the cam roller rides over the cam and causes the carriage to be advanced by a gradually accelerated movement until the die is closed. This occurs shortly before the cam roller reaches the two-lobed section of the cam. The two lobes have no effect on the carriage movement other than to exert pressure against the stiff coil springs behind the carriage, thus holding the die closed.

During this part of the cycle, crankpin *E* moves forward and backward in the slot in the connecting-rod. As this occurs, a charge of metal is introduced into the die, sufficient time being allowed for it to solidify. Then to open the die, the roller is withdrawn from contact with the cam, and the crankpin by pulling against the rear end of the slot in the connecting-rod, draws the carriage and the movable half of the die back to the position shown in Fig. 1.

The accelerated movement of the die carriage causes the die halves to come together at sufficient speed to insure proper engagement; and, conversely, withdrawal of the movable die member at an initial high speed provides sufficient force to pull the cores and eject the castings. The return movement of the die carriage is decelerated and the forward movement accelerated. This gives time for

cleaning the dies, putting inserts in place, where metal is to be cast around them, etc.

Arrangement of the Gooseneck and Elevating Mechanism

In the preceding description no account has been taken of the provisions for dipping the nozzle to fill the gooseneck with molten metal from the pot, for elevating the gooseneck to bring its nozzle into an engagement with the die, or for applying air pressure to deliver a "shot" of metal into the die. When the cam roller has almost reached the two-lobed section, the die is closed and the cam then exerts a further forward thrust on two rods *F*, this movement being made possible by further compression of springs *G* in back of the die carriage. This forward movement imparts the final rocking action to bellcranks *H* required for lifting the gooseneck, which is best seen in Fig. 2, so that its nozzle engages a nozzle plate pivoted to the frame of the machine and rocks this up in position under the gate in the die. The purpose of using this nozzle plate, instead of having the gooseneck enter directly into the gate, is to prevent any tendency to spread the two halves of the die and produce a fin on the casting. In addition to its rocking movement, the nozzle plate is elevated by sliding its pivotal supports in a vertical slot, to bring it into the proper position relative to the under side of the die.

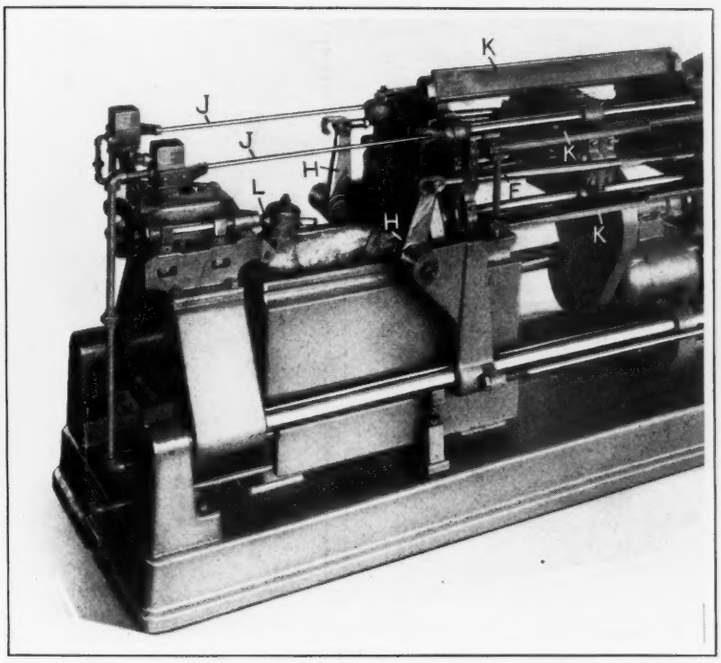


Fig. 2. Furnace, Melting Pot, Gooseneck, etc., at Rear End of Machine

With the two halves of the die together and the gooseneck in place, the machine is ready to have air pressure applied behind the metal in the gooseneck to force a "shot" into the die. This is also automatically accomplished by means of a cam on the main worm-wheel shaft, which comes into contact with roller *I* on a small bellcrank or trip, and pushes forward a rod *J* connected to an air valve at the rear end of the machine. Rod *J* is pushed forward against a compression spring, but the spring is not depended upon to protect the operator in case the air valve fails to close when released by cam *I*. At the opposite side of the machine there is an auxiliary trip mechanism of similar design, which opens an exhaust valve so that when the gooseneck is dropped out of engagement with the nozzle plate and die, the air pressure cannot squirt metal out and cause injury.

Not only must the nozzle be brought into place for delivering a "shot" of metal, but the air connection at the rear end of the gooseneck must be seated for receiving air pressure. This is accomplished by a hemispherical seat *L*, Fig. 2, entering an opening placed to receive it in the air chamber that takes pressure from the pipe line. When the air connection is broken in lowering the gooseneck, there is no back pressure of air to prevent the metal from flowing in from the pot. The air chamber has a slight sliding action against spring pressure, which insures an air-tight fit when seat *L* comes into place.

Arrangement of the Furnace and Melting Pot

The metal to be cast is melted in a cast-iron pot suspended in the furnace compartment seen at the rear end of the machine in Fig. 2. This compartment is lined with fire-brick and heated with gas. The compartment and melting pot occupy a fixed position, which also applies to the gooseneck and its elevating mechanism. To provide for setting up dies of various sizes, provision must be made for adjusting the position of the carriage and the mechanism by which it is operated. This is done by having this section of the machine carried on a slide provided with bearings on the cylindrical guide bars seen just above the bed casting. After loosening the lock-screws, the carriage and its mechanism can be adjusted to the desired position, and then locked in place. All bearings of the machine are automatically oiled by a Madison-Kipp lubricator.

The machine has already been shown to be fully automatic; the same is true of the dies. Advancing and withdrawing of all cores and the operation of knock-out pins or ejectors are controlled by cams carried on members *K*, which are known as "combination bars." Provision is made for mounting six of these bars, two on each side and two above the carriage on which the movable die half is mounted. But it is only with dies for unusually complicated castings that this number of combination bars need be used. In many cases, the desired control of cores and knock-outs will be obtained from cams on one bar, possibly operating the knock-out from a trip mechanism mounted behind the carriage.

The way in which control of the die members is effected will be more clearly understood from a description of some typical dies used in the manufacture of parts for Madison-Kipp lubricators. While these dies all happen to be for small pieces of work, they do not by any means represent the full range of work that can be successfully handled.

Fig. 3 shows the die used for making oil receiving cups, such as shown at *A*, Fig. 7. These are of

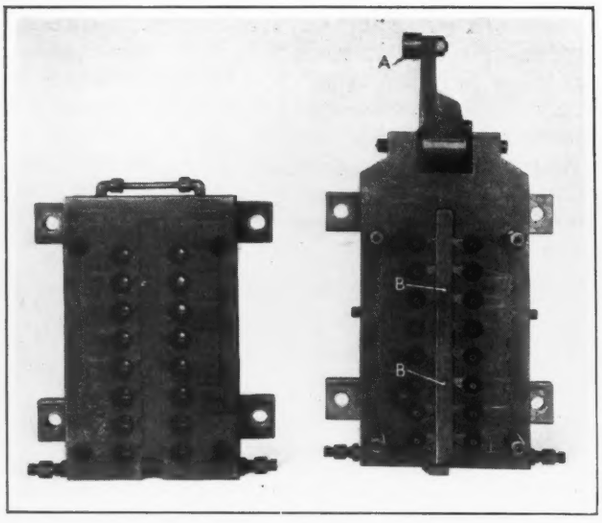


Fig. 3. Die Used to Produce 96 Cups A, Fig. 7, per Minute

simple design, and the die illustrates the productive capacity obtainable from the die-casting machine. The die is made with sixteen cavities gated together, as may be seen from Fig. 3, which shows the stationary half of the die at the left and the movable half at the right mounted on the carriage. In accordance with common practice, the two die halves are piloted together to insure accurate alignment, and the cores that form the inside of the cups are advanced or withdrawn by two slides in the die.

Each of these slides has eight inclined cam slots that receive rollers mounted at the rear of the cores. As the die carriage is making its return stroke, the cam roller *A* carried on a link at the top of the die causes this link to be rocked through the action of a cam on a combination bar *K*, Figs. 1 and 2. This action pushes the slotted slides in the die down and withdraws the cores. In so doing, the castings are stripped, and their ejection from the die is further insured by ejector pins *B*, which are pushed forward behind the metal in the gate. These ejector pins are operated by a plunger behind the die coming into contact with a fixed stop as the die carriage moves back.

On this job, the machine has been operating at the rate of six "shots" a minute, and as sixteen castings are produced at each cycle, this means ninety-six castings per minute, which does not represent the limit of output on this job. The castings weigh 0.04 pound, and the complete die, 86 1/2 pounds.

Die for Clutch Collars

In designing dies for casting many parts, it is necessary to provide for the control of interlocking cores needed to produce intersecting holes in the casting as in the case of the clutch collars shown at *B* and *C*, Fig. 7. The die for making these clutch collars is used in the position illustrated in Fig. 4 for casting one member. There are six cavities for each piece, and after a run has been completed on one casting, the die is turned upside down, the control levers *A* are connected to the other half of the die, and the run is started on the second lot of castings for which it is used. Each group of six cavities in the die is connected to a separate gate, thus dividing the die into separate sections.

In the castings produced with this die, there is a large core for each cavity, to form the central hole in the clutch collar, and a small, transverse, interlocking core. These small cores are withdrawn by the links *A* carrying rollers *B* which engage cams on the combination bars at each side of the machine. The large central cores are a fixed part of the die and are withdrawn with the movable die member, after links *A* have pulled back the small transverse cores. In this operation, the production rate is eight "shots" per minute, or forty-eight castings per minute, six castings being made with each "shot." The castings weigh 0.03 and 0.04 pounds, respectively, and the complete die weighs 86 pounds.

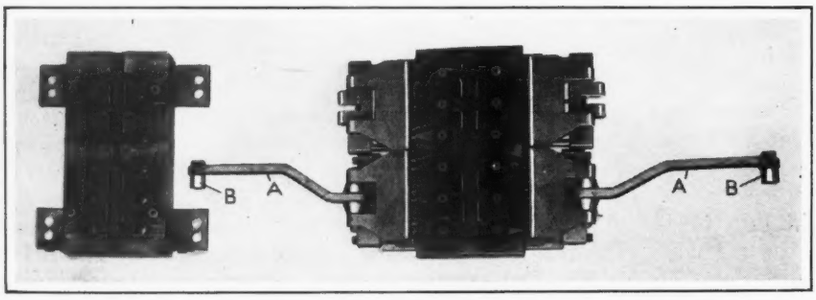


Fig. 4. Die for Parts B and C, Fig. 7, Requiring Interlocking Cores

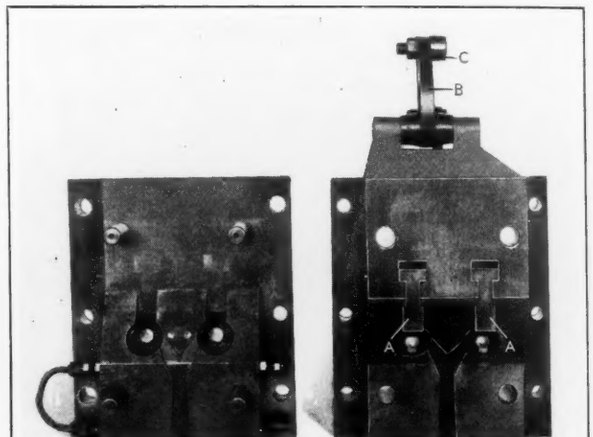


Fig. 5. Equipment for Forming Part D, Fig. 7

Dies for Lubricator Eccentrics

The die shown in Fig. 5 produces the part shown at *D*, Fig. 7, which has a blind dovetailed slot running into a cylindrical hole. There is also half of a positive jaw clutch to be formed on a hub on the opposite side of the casting from the dovetailed slot. The forming of the hub and clutch member is comparatively simple, as there is nothing to prevent ejection of the finished casting from the die cavity. The blind dovetailed slot is produced by a fixed core, the end of which fits part way around the core that forms the central hole.

The cylindrical cores for the two parts made simultaneously are withdrawn by a link mechanism and a cam roller that runs on the combination bar cam, and pulls back a plate carrying the cores.

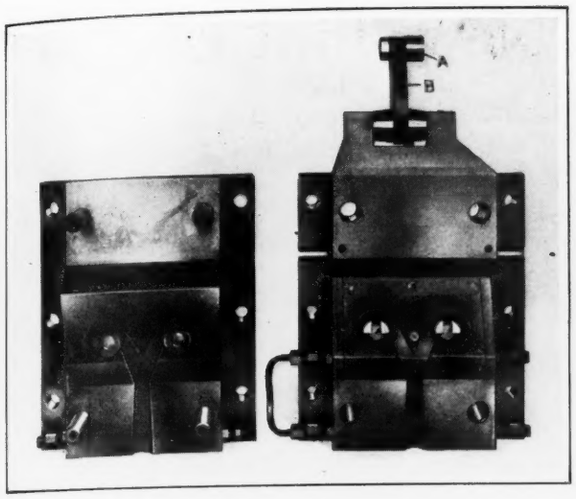


Fig. 6. Die Used to Cast Part E, Fig. 7

Then knock-out slides *A*, Fig. 5, come down on the castings and push them off the dovetailed cores, after which the castings are free to drop into the chute leading to a container. Knock-out slides *A* are operated by lever *B* and roller *C*, which is actuated from a cam on the combination bar. On this job the machine is run at eight "shots" per minute, which with the two die cavities, gives sixteen castings per minute. The castings weigh 0.07 pound, and the die weighs 108 pounds.

The die shown in Fig. 6 casts half of the eccentric member that is assembled with the one produced by the die shown in the preceding illustration. The casting is of similar form to the one with which it is assembled, except that, as shown at *E*, Fig. 7, it has a dovetailed key member that fits into the dovetailed slot of the other casting. Here, again, is a case of interlocking cores. A cylindrical core forms the round hole in the casting, and this core passes through a hole in a transverse slide that produces the dovetailed key. In operating the die, the cylindrical core is withdrawn by a link mechanism at the rear, after which cam roller *A*, Fig. 6, on rocker arm *B* withdraws the dovetailed slide through the action of a cam on the top combination bar of the machine. On this job the machine is run at eight "shots" per minute, which with the two die cavities, gives sixteen castings per minute. The castings weigh 0.12 pound, and the die weighs 125 pounds.

It will be apparent that the continuous delivery of "shots" of molten metal into the dies would rapidly raise their temperature if provision were not made for dissipating the heat. Such provision is made by channels through the die, which are connected to a water circulating system. The way in which these water connections are made may be seen by reference to any of the illustrations showing the dies. Water for cooling the dies is taken from an overhead tank and circulated by a pump.

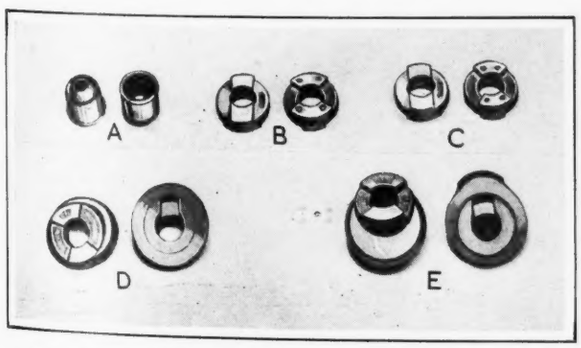
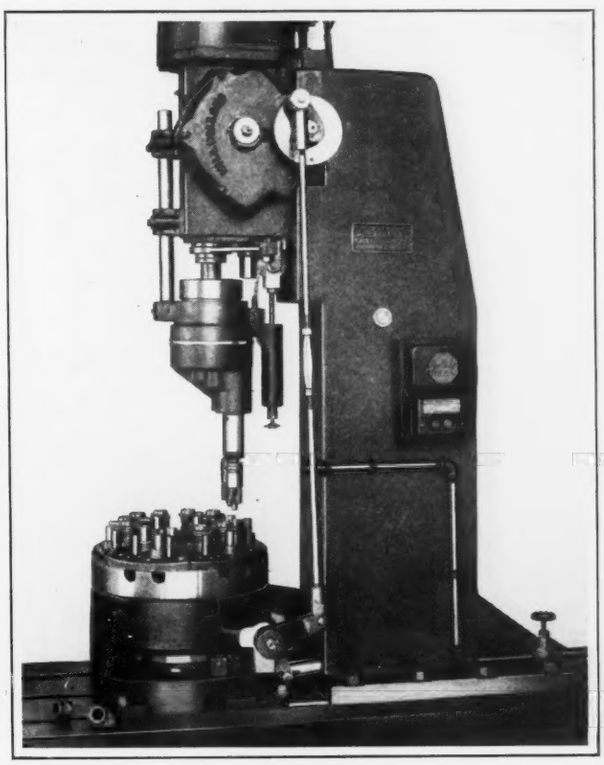


Fig. 7. Typical Pieces Produced in the Die-casting Machine

* * *

COUNTERBORING AUTOMOBILE BRAKE-PARTS AUTOMATICALLY

High rates of production are obtained in counterboring brake parts in a vertical-type automatic indexing drilling machine recently built by the Millholland Sales & Engineering Co., 230 S. Pennsylvania St., Indianapolis, Ind. As may be seen from the illustration, this machine is equipped with two spindles for simultaneously counterboring two parts. There is a six-station indexing table on which twelve parts can be placed at one time. As the table indexes once every 9.5 seconds, the time per piece is 4.75 seconds.



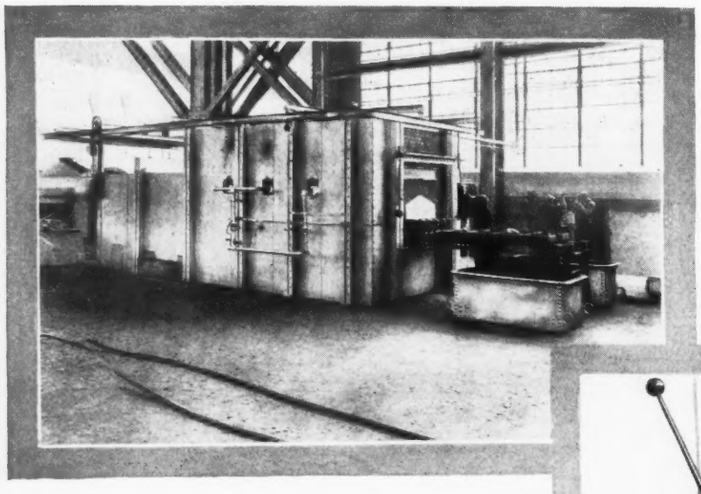
Operation in which Two Brake-parts are Counterbored Every 9.5 Seconds

The cam has a dwell during the last part of the feeding stroke which insures cuts of uniform depth. At the end of the stroke, a lock-bolt is withdrawn, and the table indexes automatically to the next station where the lock-bolt again locates it accurately. The spindle is counterbalanced with a weight in the column. The return of the spindle is cushioned by an air shock absorber which is mounted on the multiple-drill head on the side toward the column. The machine can be kept indexing continuously or stopped after the cycle has been repeated any desired number of times.

With the exception of the special equipment for this job, the machine is of the same general design as the one described in January MACHINERY. It can be arranged to handle a number of different parts and to perform different operations.

Operations on the New Ford Car

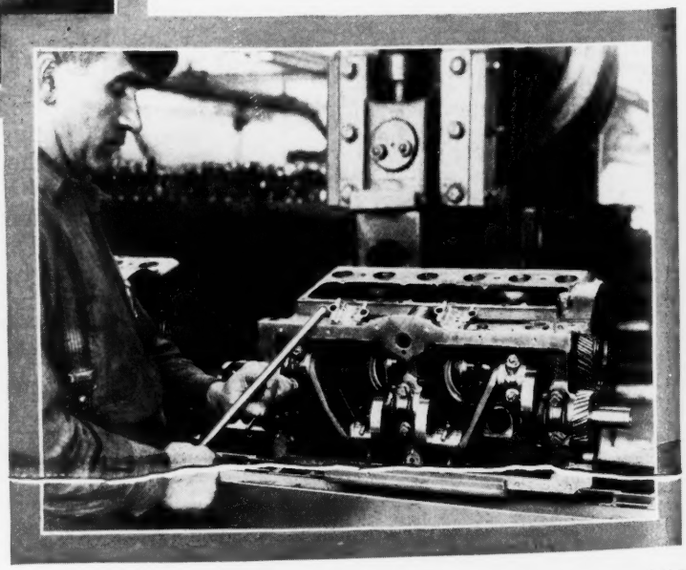
A Few of the Steps Preceding the Main Assembly



(Left) Gas-fired Annealing Furnace with Automatic Timing Control for Differential Ring Gears. In the Ford Plants there are Over 400 Gas-fired Furnaces for Industrial Heating Processes, and the Plant Uses Approximately 50,000,000 Cubic Feet of Gas Daily for Different Operations Throughout the Entire Process of Manufacture

All the Individual Units of the Car are Separately Assembled and Tested, Ready for the Final Assembly, so that They are Merely Bolted into Place as the Chassis Passes Along, Moved at a Regular Rate of Speed by a Chain Conveyor. The Illustration to the Right Shows the Assembling of the Clutch

(Left) Fitting the Pistons to the Engine. The Pistons, 3 7/8 Inches in Diameter, are Made from Aluminum with Piston-pins of Seamless Steel Tubing, 1 Inch in Diameter, of the Floating Type. The Pistons Fit the Cylinder Walls Within Limits of 0.002 to 0.004 Inch

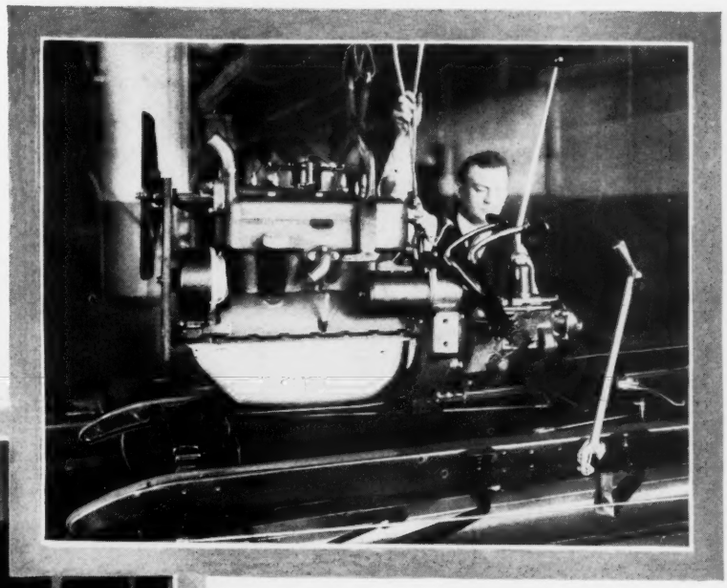


Each Operator Performs a Distinct Operation in the Assembly as the Engine, Passing Along on a Conveyor, Moves Past Him. In This Way Each Operator Becomes an Expert on the Particular Work that He Performs. The Illustration to the Right Shows the Engine Assembly Nearing Completion, with Pistons and Connecting-rods in Place and the Balanced Crankshaft in Position

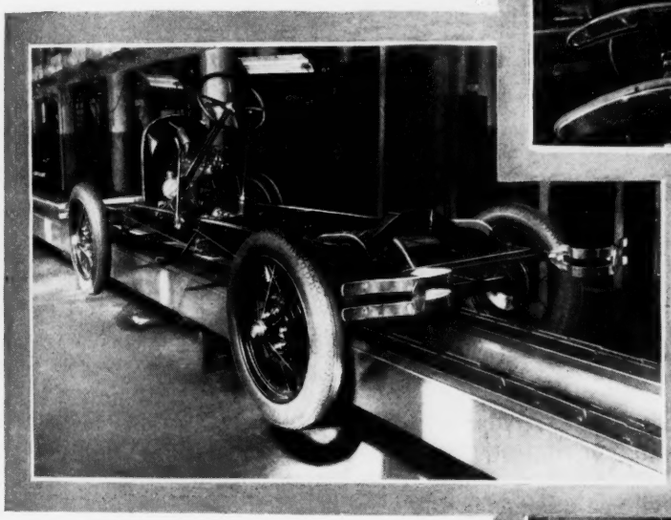
Photographs by Courtesy of the American Gas Association

Progressive Assembly in the Fordson Plant

The Chassis Moves Steadily Along the Line Until the Car is Completed

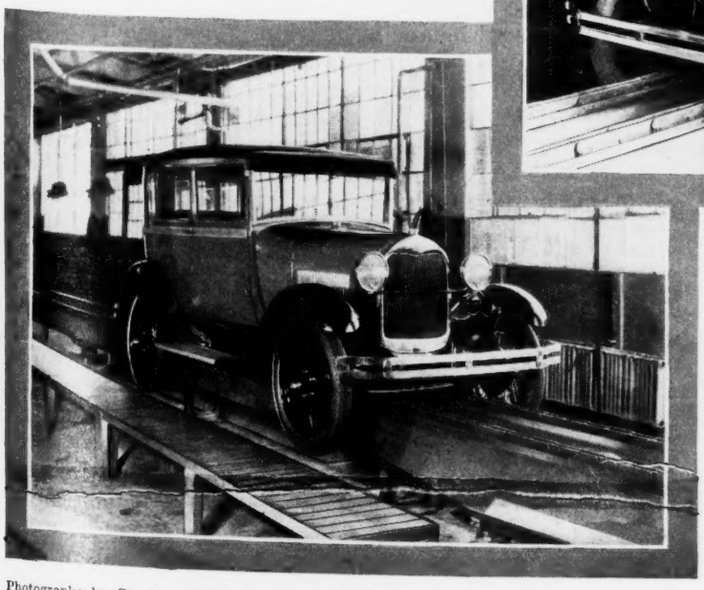


As the Chassis Moves Along on Its Conveyor, the Engine is Dropped on It. The Chain Conveyor is Constantly Moving the Chassis Forward, and All Operations are Performed Along the Assembly Line as the Chassis Proceeds



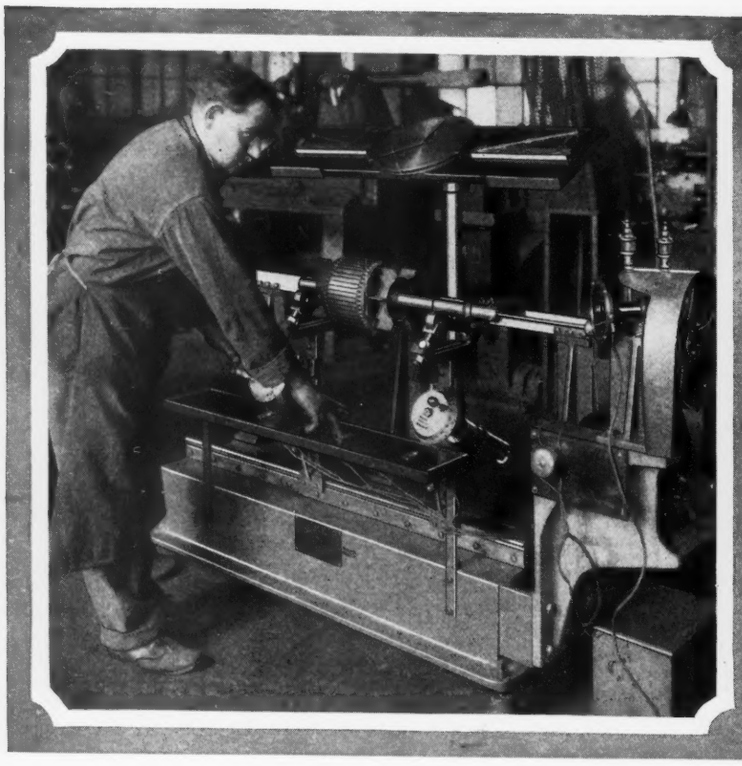
The Illustration to the Left Shows the Chassis Completely Assembled, and Gives a Good Idea of the Chain Conveyor of the Assembly Line

The Body is Now Dropped on the Chassis, as Shown to the Right, and After a Few Additional Assembling Operations, the Completed Car Reaches the End of the Assembly Line



When the Car is Ready to Pass from the Assembly Line Its Gasoline Tank is Filled, a Driver is in the Seat, and the Car is Driven Off from the Line Under Its Own Power, All Ready for the Final Inspection and Tests

Photographs by Courtesy of the American Gas Association



Balancing Rotating Parts By a New Method

A Description of the Olsen-Lundgren Process in which the Amounts and Angular Locations of Unbalance in a Part are Determined without Rotating the Work at the Critical Speed

By CHARLES O. HERB

THE balancing of parts statically and dynamically is becoming increasingly important in the manufacture of all machinery embodying members that rotate at a comparatively high speed. Less than ten years ago, even the manufacturers of the highest priced automobiles did not consider it necessary to balance the crankshaft. Today, with the recent advent of the new Ford models, the crankshafts of all passenger cars are balanced statically and dynamically before they are assembled into engines.

In other fields of manufacture, the adoption of static and dynamic balancing is also progressing. It is common practice in the machine tool field to balance the spindles of grinding machines, belt pulleys, etc.; in the electrical tool industry, the spindles of portable drills and grinders are balanced; in building electrical machinery, the balancing operation is performed on armatures for motors, generators, and similar equipment; and in the manufacture of woodworking machinery, it is considered necessary to balance such important parts as cutter cylinders.

Advantages Derived from Balancing

When a part is perfectly balanced, there will be no vibration, even though the part is rotated at a high speed. Lack of dynamic balance in a rotating part may cause vibration not only of the part itself but of the entire machine. Excessive vibration will cause bearings and other parts of a machine to wear out rapidly and may affect the accuracy of the operation performed. For instance, if the wheel-spindle of a cylindrical grinding machine is out of balance, the vibrations will probably result in chatter marks on the work. Also, if the crankshaft of an automobile engine is out of balance, the vibrations set up are likely to be felt over the whole car. Since by balancing rotating parts, destructive vibration is eliminated, it is small wonder that proper balancing is constantly growing in favor.

The Olsen-Lundgren Method of Determining Static and Dynamic Unbalance

Various types of machines are employed for determining the amounts and angular locations of dynamic unbalance in a rotating part. However, until the recent development of an Olsen-Lundgren centrifugal balancing machine for this purpose by the Tinius Olsen Testing Machine Co., Philadelphia, Pa., machines have generally been designed on the principle of revolving the work up to and beyond its critical speed. In the new machine, the slightest movement imparted by the unbalanced force is so closely detected that it is unnecessary to revolve the work at anywhere near the critical speed. Light work is revolved at only 260 revolutions per minute, and heavier parts at a speed of approximately 130 revolutions per minute.

The amount and location of both static and dynamic unbalance can be quickly determined at both ends of a part with one setting of the work in the machine. By merely observing electric sparks produced on a dial as an unbalanced part is revolved, the operator can instantly tell whether the part is out of balance statically, dynamically, or in both ways. The angular planes of unbalanced forces are also determined from this dial, while

the amounts of unbalance are shown by the graduated dials of handwheels which are turned until the unbalance has been compensated for by shifting weights to change the center of gravity of the work and the standards which support it. An unskilled operator can easily be taught in a half hour to operate the machine.

The amounts of unbalance are read in ounce-inches from the handwheel dials. These are graduated to read in increments of 0.050 ounce-inch in the size of machine illustrated, and as the graduations are about 3/8 inch apart, closer readings can be approximated. When the machine is used for one part and the lengthwise locations of the unbalanced forces are pre-selected, a chart is supplied from which the amounts of metal to be removed from or added to the work for any given amounts of unbalance can be readily determined. For use in balancing automobile crankshafts, as an example, such a chart would show the depth to which compensating holes should be drilled with various sizes of drills in predetermined planes.

Essentials of Machine Construction

Work to be tested in the machine is supported at each end by two rollers *A*, Fig. 2. Each pair of these rollers is mounted in a bracket *B* attached to the top end of an upright member *C*. The two uprights are adjustable along a machined way of the base to suit the length of work. The lower ends of the uprights consist of brackets *D*, Fig. 1, in each of which a flat spring is mounted. Uprights *C*, Fig. 2, are fastened to the flat springs, the construction being such as to permit the uprights to vibrate freely in a horizontal plane due to any unbalance in a part rotated on rollers *A*.

Mounted on the rear end of each casting *B*, there is a small copper plate carrying a platinum point which comes in contact with the inner copper end of a screw *E*, also having a platinum contact point whenever the plane of an unbalanced force in the work reaches the forward horizontal position as the work is revolved. An opposing set-screw *F* acts as a stop for the backward movement of the upright, and whenever the machine is idle, the plate fastened to the rear end of casting *B* also rests against this screw. Screws *E* and *F* are adjustable to limit the movement of the upright, a movement

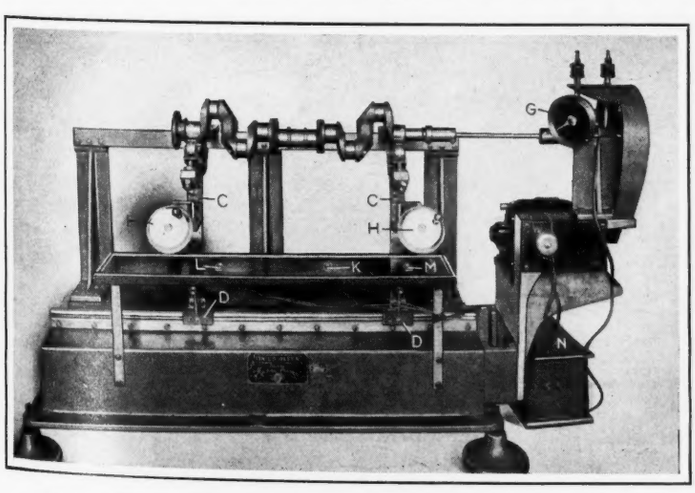


Fig. 1. Determining the Amount and Location of Unbalanced Forces in an Automobile Crankshaft

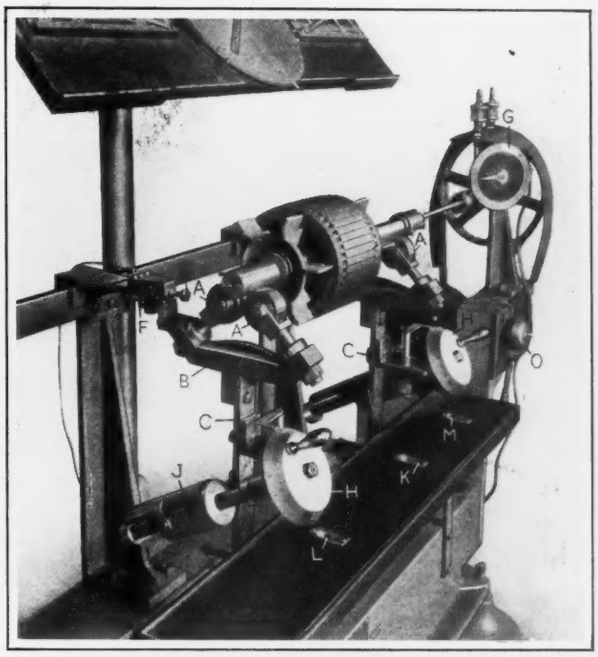


Fig. 2. The Work Supports and Their Devices for Shifting the Center of Gravity

of only 0.001 inch of bracket *B* being sufficient to bring the copper plate at the back of the bracket into contact with screw *E*.

Each time the platinum point on the copper plate of either of castings *B* touches its corresponding screw *E*, an electrical contact is made which is transferred through a high-tension vibrating coil to the dial indicator *G* at the right-hand end of the machine, causing sparks to jump from the end of the pointer to the circular rim. By observing these sparks, the kind and angular locations of any unbalance in the work can be immediately determined. The corresponding handwheel *H* is then revolved to adjust the position of a weight *J*, and thus shift the center of gravity of upright *C* and the work to compensate for the existing unbalance. The correction necessary on the work for the unbalance can then be determined from the graduations on the handwheel dial.

When switch *K* is engaged, dial *G* registers the unbalance in the right-hand end of the work, and when switch *K* is turned off and switch *L* is closed, the dial shows the unbalance in the left-hand end. Switch *M* controls the batteries and coil in box *N*, Fig. 1, which energizes the circuit between the copper contact plates of the two uprights and dial *G*. Switch *O*, Fig. 2, controls the motor which drives the work and the mechanism of dial *G* in synchronism with it.

Procedure in Balancing a Part

The machine is particularly suited for use in the quantity production of one part. In such an operation, it is the general custom to select two planes along its length where corrections for unbalance are to be made, so that in the balancing operation it is only necessary to determine the amounts and angular locations of the unbalanced forces. Automobile crankshafts are sometimes made a trifle heavy

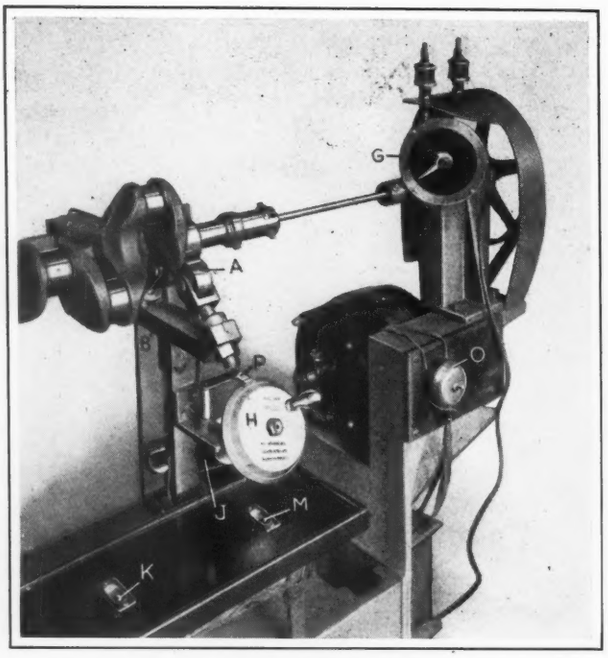


Fig. 3. Right-hand Work Support and the Dial that Indicates the Kind of Unbalanced Force and its Angular Plane

in a cheek adjacent to each end where it is desirable to correct for unbalance.

Figs. 1 and 3 show the machine being employed for determining the unbalance in a crankshaft. For such an operation, the crankshaft is laid on rollers *A*, as shown, and connected to the drive through a universal coupling near the right-hand end of the machine. After the machine has been started, switches *K* and *M* are closed, and sparks immediately pass between the pointer and the outer rim of dial *G* each time that the heavy plane of the right-hand end of the crankshaft reaches the forward horizontal position. Of course, the copper plate at the rear end of upright casting *B* touches its corresponding contact screw for a sufficient period of time at first to permit several sparks to be produced in rapid succession. The angle indicated on dial *G* midway between the points where the sparks occur is the plane in which the correction must be made for the unbalance of that end.

Handwheel *H* is then revolved until its weight *J* has been shifted sufficiently to compensate for the unbalanced force, at which time the sparks cease. Then the machine is stopped, the crankshaft is revolved by hand until the dial pointer indicates the graduation which had been at the center of the sparks, and a chalk mark is placed in the horizontal plane of the crankshaft at the point where the work has been pre-selected to be out of balance. The graduation of handwheel *H* which registered at the index line of arm *P* when the sparks ceased is then observed. This will give a reading in ounce-inches of the necessary correction to compensate for the unbalance of the right-hand end. As previously mentioned, the graduations on the handwheel dial are to 0.050 ounce-inch and are about 3/8 inch apart.

Switch *K* is next opened and switch *L*, Fig. 1, closed, after which the unbalance of the left-hand end is determined in the same manner as for the opposite end. If the sparks obtained in checking the left-hand end appear in the plane directly opposite to that in which the sparks occurred in the right-hand end, it will be known that a dynamic couple exists in the crankshaft. However, if the sparks occur in the same plane, there is merely a static unbalance. Should the sparks be neither directly opposite nor in the same plane, there is indication of combined static and dynamic unbalance. At the beginning of each operation, switches *K* and *L* may be closed at the same time in order to determine from the sparks created whether the unbalance is static, dynamic, or a combination of the two.

Strictly speaking, the unbalance is not determined at the points of pre-selected correction, but rather at the points where the crankshaft is supported. However, charts are provided when the machine is used constantly on one part, so that the compensations to be made at the correction points determined from handwheels *H* can be immediately found by simply referring to the charts. Such charts give the depth of holes to be drilled by various sizes of drills to compensate for the unbalance. Similar parts to be tested, such as crankshafts, for instance, are generally located in the machine in the same manner from a key slot, etc.

Fig. 4 shows the machine being employed for determining the unbalance of an automobile flywheel. This part is slipped on one end of a properly counterbalanced mandrel *Q*, which is connected to the universal coupling at the right-hand end. Readings are taken from the dial and both handwheels, as in the case of the crankshaft, and corrections are also determined from a chart.

Universal Use of the Machine

Universal use of the machine is also simply accomplished. Various sizes and kinds of parts can be accommodated by merely adjusting the upright supports along the base and revolving the graduated nuts *R*, Fig. 5, to adjust the rollers *A* to suit the diameter of the surfaces by which the work is to be supported. Unbalance in each end of a given part is then determined in the same manner as in the case of the crankshaft; however, since charts are unavailable for universal use of the machine, it becomes necessary to compute the actual amounts of metal to be added or removed in the various planes that may be selected for the correction. These computations are facilitated by means of the instruments on the board seen in Fig. 5 and in the heading illustration.

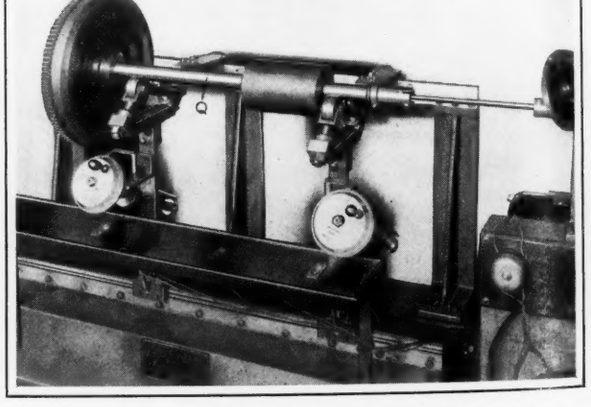


Fig. 4. Set-up Used in Checking the Unbalance of an Automobile Flywheel

The instruments on the right- and left-hand ends of the board are used in an identical manner for the right- and left-hand ends, respectively, of the work, while the large dial *T* in the middle is used in conjunction with the other instruments. For example, suppose it is desired to determine the number of ounce-inches to be removed from the left-hand end of the armature in Fig. 5; then scales *W*, *X*, and *Y* would be spaced in the same relation to each other as the left-hand point of work support, left-hand point of work correction, and right-hand point of work correction. The pivot of rod *Z* would be placed to correspond with the location of the right-hand point of work support.

Assume that, in determining the unbalance at both ends of the armature, it is found that for an unbalance at the left-hand point of support a correction of 2 ounce-inches is required at an angle of 20 degrees from the center line of the key by means of which the armature is located in the machine, and that at the right-hand point of support, a correction of 5 ounce-inches is necessary at an angle of 250 degrees.

Then, to determine the correction to be actually made at the left-hand point of correction, rod *Z* is swiveled to coincide with the 2 ounce-inch graduation on scale *X*, after which 2.7 ounce-inches will be read from the intersection of rod *Z* with scale *W*. Rod *Z* is next shifted to the 5 ounce-inch graduation on scale *X*, and 2.6 ounce-inches is read from the intersection of the rod with scale *Y*. Two new values of correction, 2.7 ounce-inches at 20 degrees and 2.6 ounce-inches at 250 degrees, have thus been obtained.

To determine the amount of metal to be removed from one plane, which also must be computed, reference is next made to dial *T*. This dial has a bar *U* which is free to slide vertically and to which a swivel bar *V* is attached. Dial *T* is first revolved until the 20-degree graduation coincides with the center line of the slot in which bar *U* moves. Then, with the pivot point of bar *V* in the center of the dial, this bar is swiveled into line with the 250-degree graduation of the dial. Bar *U* is next shifted upward until the center line of the pivot reaches the 2.7 graduation on scale *S*, after which the location of the 2.6 graduation on bar *V* is observed and this point of intersection carried to the rim of the disk, where a reading of approximately 318 degrees will be interpolated.

Next, the nearest circle on dial *T* to the 2.6 graduation on bar *V* is followed to scale *S*, where a reading of 2.25 ounce-inches is observed. Hence, the proper correction at the left-hand end for the unbalanced forces in the work is 2.25 ounce-inches at a point 318 degrees from the radial location of the work in the machine.

While the method of using these instruments may seem somewhat complex from the explanation, the computations can actually be made with dispatch. The computations are generally made while the work is still in the machine, so that it is an easy matter to revolve the work to the proper correction plane, as indicated on dial *G*, and then mark the work with chalk to facilitate the subsequent removal or addition of the compensating weight.

It is emphasized, again, that the instruments are only required when the work is of such a great variety during a day's run that it would be impracticable to resort to a chart for every piece tested.

What this balancing machine actually does is to measure the pressure of the centrifugal force caused at each bearing support by an unbalanced condition in the piece being tested. The amount of this force is determined by moving a counterweight away from the center line of the support so as to counteract the pressure and cause the support stand to stop vibrating. The plane or angle of unbalance is determined by the location of the spark on the dial when contact is made between the platinum points. The chances of error in determining unbalance by this method are very small, as the skill of the operator is not a factor in the operation.

In checking or inspecting the machine, it is only necessary to set the machine or each support out of balance to the amount of the allowable limits on the work. Then when the work is brought up to speed, no spark will appear if the piece is balanced

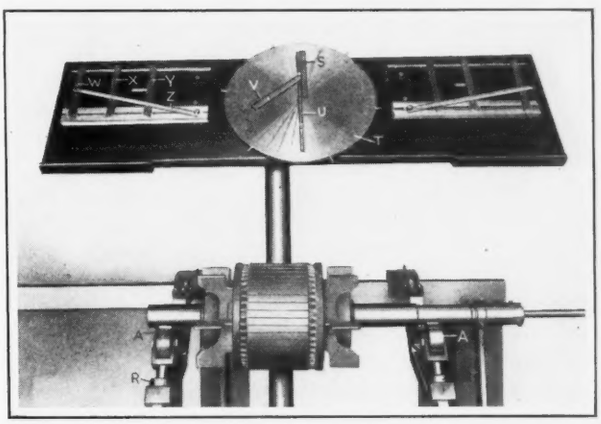


Fig. 5. Instruments Used in Computing the Actual Corrections to be Made when the Machine is Employed Universally

within the limits. If not balanced within the limits, readings are taken in the general way heretofore described.

This machine is made in various sizes and lengths to suit different classes of work from 1/2 pound and up in weight.

* * *

NEW NORTON MOTION PICTURE FILM

"The Thirtieth Part of a Hair" is the title of a new motion picture film just produced by the Norton Co., Worcester, Mass. This film is a picture story of the accuracy of the manufacturing methods used in building grinding machines. The film is of interest both to the mechanical man and the general public. It opens with some interesting pictures of high-speed traveling in the air and over land, and shows the part that grinding plays in the building of the engines that have made speed possible. Then follow pictures on the construction of grinding machines. The film is essentially an educational one in character. It is two reels long, printed on safety stock of both standard and 16 millimeters width. It may be obtained for use without cost, by any organization interested in showing it, from the Publicity Department of the Norton Co., Worcester, Mass.

IMPORTANT MERGER IN THE GEAR INDUSTRY

Under the name of Gears & Forgings, Inc., a new corporation has been formed, consisting of four well-known concerns in the gear and forging field —the Van Dorn & Dutton Co., Cleveland, Ohio; the William Ganschow Co., Chicago, Ill.; the Fawcus Machine Co., Pittsburg, Pa.; and the Ohio Forge Co., Cleveland, Ohio. Including, as this new consolidation does, both manufacturers of gears and of forgings, the new corporation will control production from the raw material to the finished gears.

The Van Dorn & Dutton Co. was founded in 1897 and has been manufacturing gears on a constantly increasing scale for over thirty years. F. W. Sinram, one of the best-known men in the gearing field, has been president and general manager of the company for many years. Mr. Sinram also was one of the leaders in the formation of the American Gear Manufacturers' Association and was elected the first president of this association in 1917. He served continuously in this capacity until 1923, when he felt it necessary to refuse re-election and was made honorary president for life. Mr. Sinram will be the president of Gears & Forgings, Inc., with headquarters on Woodhill Road, Cleveland, Ohio, at the present offices of the Van Dorn & Dutton Co.

The William Ganschow Co. was organized about fifty years ago as the first gear manufacturing concern in Chicago making general industrial gears, and later becoming important manufacturers of speed reducers. The business has expanded until at present the company has a plant both in Chicago and in Peoria, Ill. William Ganschow, for many years president of this company, will be second vice-president of the new corporation and manager of the Ganschow Division.

The Fawcus Machine Co. was organized in Pittsburg in 1901, and has grown to be one of the largest manufacturers of heavy industrial gears, herringbone gears, and special machinery, having at present two plants, one in Pittsburg and one in Ford City, Pa. In addition to gears, this company builds special steel mill equipment, including gear transmissions of from 100 to 15,000 horsepower, and machinery for mechanically operated bridges. A. F. Cooke, vice-president and general manager of the Fawcus Machine Co., will be first vice-president of the new corporation and manager of the Fawcus Division.

The Ohio Forge Co. has been in business for twenty-five years and has grown in that period from a one man, one hammer shop to a seven-unit plant located on 4 acres of ground. Its growth has been chiefly due to the efforts of two men, J. M. Clem and S. C. Dalbey. Mr. Clem will be third vice-president of the new corporation and manager of the Ohio Forge Division. Mr. Dalbey will be a director and secretary and treasurer of the new company.

T. E. Leighton, formerly secretary of the Van Dorn & Dutton Co., will be a director and assistant secretary and treasurer; C. F. Goedke, formerly secretary of the William Ganschow Co., will be a director and district sales manager with headquarters at Chicago; and H. B. Newell, long the assistant of A. F. Cooke at the Fawcus Machine Co., will be a director and chief engineer of the corporation.

The new corporation plans to establish efficient sales and service forces throughout the country, and district sales offices will be maintained at principal points of distribution throughout the United States.

* * *

SAFETY DON'TS IN THE SHOP

By W. S. BROWN

The following "don'ts," intended to promote safety in the shop, have been prepared as a result of careful observations in a large, well managed plant.

Don't leave cut-off ends of round rods or shafting on the floor, but instead, place them in a box provided for the purpose.

Don't throw used matches on the stairs, as they present an untidy appearance and are often the cause of falling.

Don't, if you *must* use a file without a handle, place the file in a hole in the casting with the tang projecting; it is not easily seen by other workmen and may cause serious injury.

Don't leave nails projecting from the floor when removing scaffolding from temporary platforms, as the nails may easily pierce the sole of an ordinary shoe and inflict serious injury.

Don't hang your coat or tools on the gangway side of a post; drive the nail for holding the coat or tool on the other side of the post where it will not catch the clothing of a passing workman.

Don't leave ragged edges on machined steel parts; one minute with a file may save the inconvenience of wearing a bandage for a week.

Don't use waste cans, oil guards, or deflectors having ragged or split edges.

Don't remove cover plates from floor holes and forget to replace them; more than one person has stepped back into such openings and been injured.

Don't drill out large holes in floor plates, leaving a ragged edge, but instead, use the cutting torch, which is cheaper and will give a better job.

Don't allow the extension belt shifter to extend out over the machine, as it may be hit by some other operator taller than yourself.

Don't allow a shaft to extend out in mid-air without placing a flag or some indicating device on the shaft.

Don't leave temporary fuel oil pipes, air lines, and electric cables across gangways without making their presence conspicuous by painting or marking them in some way.

Don't chisel or chip castings when someone is in the line of flight of the chips; exercise care in protecting the eyesight of others and when chipping, wear goggles to protect your own eyes.

Don't hang your machine light in such a position that the switch can become mixed up with a control handwheel.

Don't use a hand lamp with frayed or defective wiring.

Don't tolerate exposed or "live" type electrical machine starters; guards are inexpensive and protect the workman, who might possibly fall against the exposed starter.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

CINCINNATI SELF-CONTAINED ROLL GRINDER

A plain self-contained roll grinder, with 24 inches of swing and forced-feed table lubrication, has just been brought out by Cincinnati Grinders, Inc., Cincinnati, Ohio. The machine is built in thirteen different lengths, from 48 to 336 inches, in 2-foot intervals. It resembles, in method of control, the Cincinnati 12- and 16-inch plain self-contained grinding machines described in February, 1925, MACHINERY. However, the new machine is considerably larger, proportionately heavier, and more powerful. The weight is approximately 30,000 pounds.

The system of oiling the table guides is quite different from the customary design. Instead of having oil distributing pockets with rollers in the bed, the vee and flat table ways are flooded with filtered oil by a pump geared directly to the drive shaft. Oil is pumped from a central tank to the table guides at a pressure of about 4 pounds per square inch and distributed through oil-grooves on the under side of the sliding table. No matter how short the traverse, the ways are always flooded with clean oil.

In draining back to the central tank, the oil passes through a settling chamber at each end of the bed and a "Purolator" filter, which removes all grit, dirt, and sediment. This system of table lubrication is incorporated in the machine under a lease from the Gray Planer Co., Cincinnati, Ohio. For the rest of the machine, the lubrication system is centralized at a few points and requires infrequent attention.

All standard machines are built with single tables; however, machines up to 144 inches between centers have been designed with two tables—an upper work or swivel table, and a lower sliding table. The swivel table permits tapers 12 feet in length to be ground. On single-table machines, a set-over construction in the footstock, Fig. 2, takes care of any misalignment between the work-centers and insures the grinding of parallel work. Short tapers can be ground if the cutting face of the grinding wheel is dressed to the desired angle and brought straight into the work. A safety friction clutch comes into operation in case the machine is jammed by accident and also functions at each reversal of the table.

All of the table traverse speeds, twelve in number, are obtained through sliding gears. The gearbox is mounted on the back of the grinder bed, and is controlled through a single lever at the front.

A 30-horsepower motor is coupled to the main drive shaft by means of a flexible coupling, which may be seen in Fig. 3. The spindle is driven from the main shaft through a multiple-strand "Texrope" drive, which runs over idlers that allow for adjustments of the wheel-slide. Inspection of the moving parts of the drive is facilitated by openings in both the wheel-head and bed, which are provided with suitable guards.

The wheel-head is of a heavy design, and is mounted on large vee and flat bearings. Its weight, in addition to the downward pull of the "Texropes," holds the slide on the ways under the heaviest cuts. The wheel-head is also balanced by a counterweight to insure smooth in-feeding and accurate sizing on all diameters of work. The wheel-spindle is automatically lubricated by a generous flow of oil. End thrust of the spindle is taken by a double thrust ball bearing which can be adjusted easily, while the spindle is running, by means of a knurled nut outside of the bearing.

All levers and wheels controlling the movements of the machine are within easy reach of the operator from a central position. A mirror attachment enables the operator to see the point of contact between the wheel and the work without bending over the machine.

The motor-driven headstock is controlled by a rheostat mounted on the right front of the machine, which, in turn, operates through a dynamic brak-

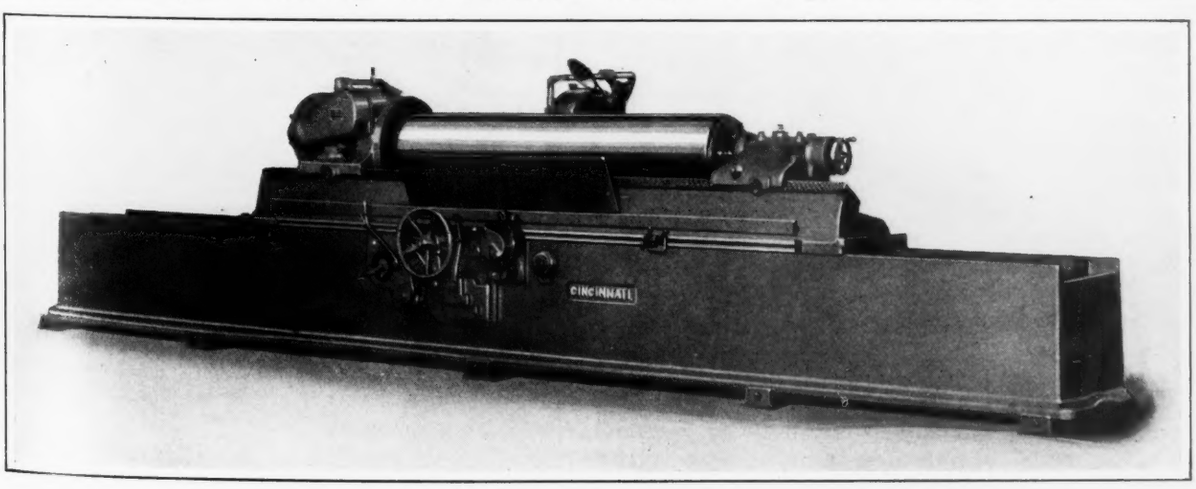


Fig. 1. Cincinnati Plain Self-contained Roll Grinder for Large-diameter Work

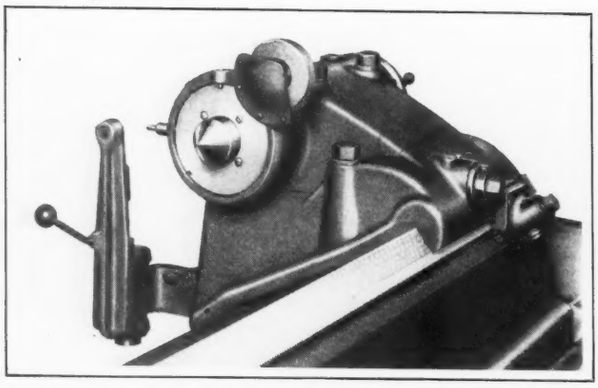


Fig. 2. Grinder Footstock and Truing Fixture

ing panel. Worm-gearing transmits power from the "Texrope" drive to the faceplate. Equipped with a three-horsepower motor, the driving plate has a speed range of from 11 to 96 revolutions per minute. The work headstock is of the dead-center type. When direct current is not available, a generator equipped with a rheostat for voltage regulation is built into the machine to produce the required direct current for the headstock motor.

The footstock is equipped with two types of wheel-truing devices. Either a roll type of truing fixture or a diamond can be used. The radius truing fixture shown mounted on the footstock in

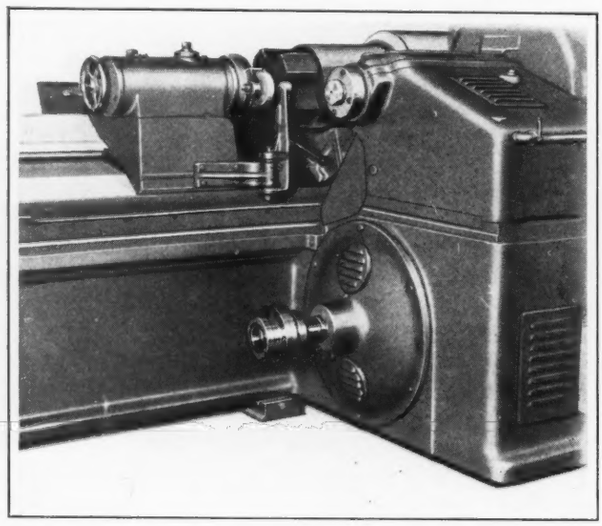


Fig. 3. View Showing Flexible Coupling for Motor Connection

Fig. 2 rounds the edge of the grinding wheel for grinding fillets on rolls. The coolant pump is of the centrifugal type and does not require priming.

To secure and maintain alignment of the grinder on its foundation, a complete set of wedge blocks is furnished on which the bed is mounted when installed in a plant.

WARDWELL DOUBLE-ACTING BAND-SAW FILER AND SETTER

A band-saw filer and setter which files each tooth in the direction in which it is set has been added to the line of saw sharpening machinery built by the Wardwell Mfg. Co., 111 Hamilton Ave., Cleveland, Ohio. In previous machines built by the company, the teeth were all filed on one side, with the result that on the side filed against the set, the set was frequently lost or diminished by the pressure of the file. With the new design, the set remains true on both sides. Another feature of the improved machine is that two teeth are set at the same time, thereby preventing any spring in the saw or rocking of the saw in the setting process. Both setters are controlled by one common adjustment, it being necessary to simply turn a screw to change the amount of set given to a saw.

This new model G machine is made in both pedestal and bench models. Either of these may be provided with a direct-connected motor drive and the bench machine may also be furnished with a belt drive. Fig. 1 shows the pedestal machine pro-

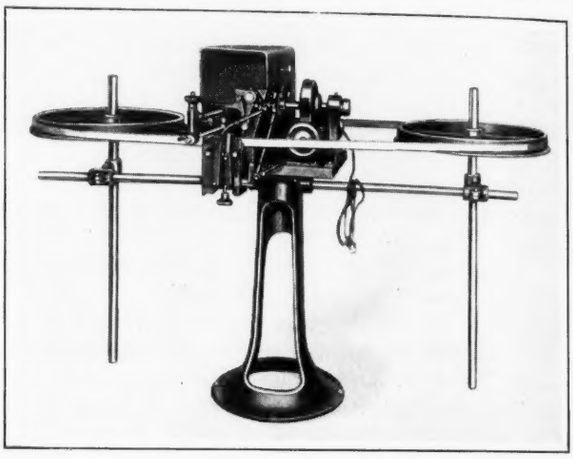


Fig. 1. Wardwell Band-saw Filer and Setter

vided with saw supports attached to the pedestal, while Fig. 2 shows the belt-driven bench machine. Mechanical features of both models include an eccentric having a take-up for wear. The main drive shaft runs in Timken tapered roller bearings, and the thrust of the motor worm shaft is taken by a ball bearing. The connection between the motor and the drive shaft is a flexible coupling.

Band saws from 1/8 to 2 inches in width and having from two to fifteen teeth per inch, can be filed, set, and jointed in one operation at the rate of seventy teeth a minute. Standard double-end taper files are employed. With a motor drive, a motor of 1/4 horsepower running at 1750 revolutions per minute is employed. Power for driving this motor may be taken from a lamp socket.

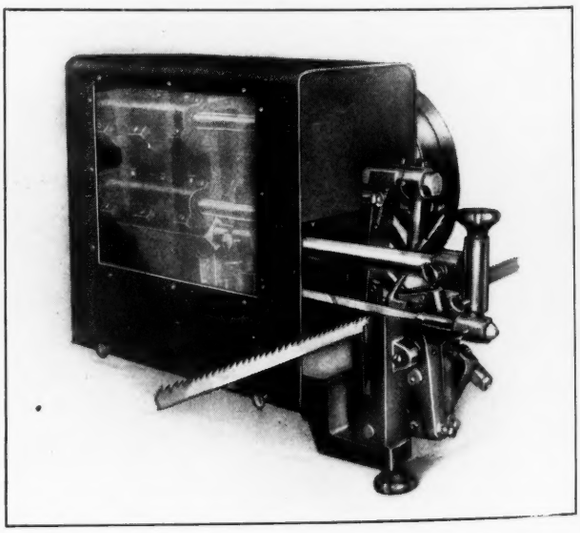


Fig. 2. Bench Type of Band-saw Filing and Setting Machine

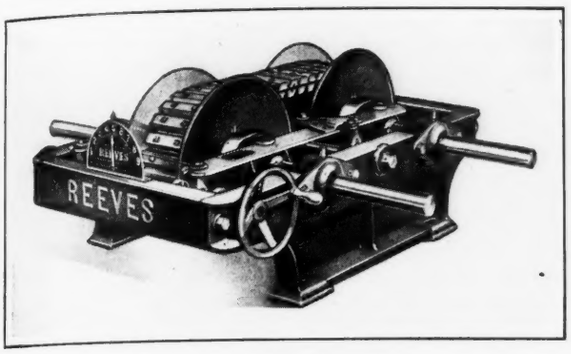


Fig. 1. Reeves Improved Variable-speed Transmission

REEVES VARIABLE-SPEED TRANSMISSION

Several major improvements have recently been made in the variable-speed transmission manufactured by the Reeves Pulley Co., Columbus, Ind. The most important improvement is a double-block center-pull V-belt of the design shown in Fig. 2, which transmits from 20 to 25 per cent more power than the single-block V-belt which was formerly used. With the double-block construction, the center line of pull is at the exact center of the belt body and the load is evenly distributed above and below. The new belt can be run slack, which lengthens its life and reduces the load.

A different type of splice block is used than before, the new block being of a double-pin interlocking type with cast-aluminum blocks and tool-

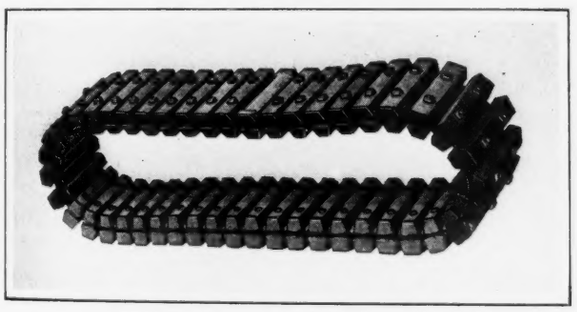


Fig. 2. V-belt of Double-block Construction Used in Reeves Transmission

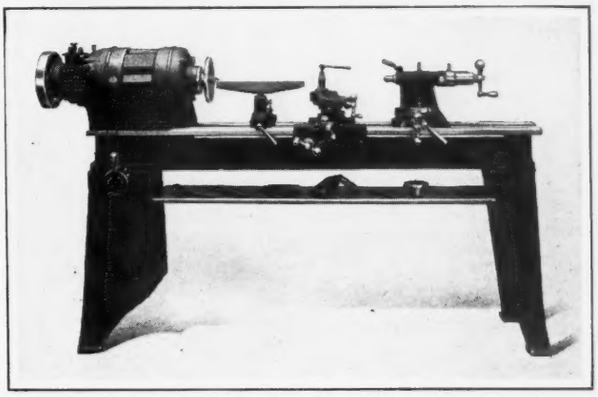
steel plates, making an unusually strong construction. The transmission itself is shorter and narrower, because of a new compact frame. There is also a new method of forced-feed lubrication, particularly for the thrust bearings and the disks. Standard equipment includes a speed indicator mounted on the frame, where the operator can always see at a glance the approximate speed at which the transmission is running.

BLOUNT MULTI-SPEED MOTOR-HEADSTOCK LATHE

A pattern-shop lathe driven by a two-horsepower motor embodied in the headstock has been placed on the market by the J. G. Blount Co., Everett, Mass. The motor is of the squirrel-cage multi-speed type, fully enclosed and dustproof. The main spindle speeds are 575, 1160, 1725, and 3450 revolutions per minute, while the jack spindle speeds which are obtained through a gear reduction, are 287, 580, 862, and 1725 revolutions per minute. The jack spindle feature is of importance in turning work of larger diameter than the swing of the lathe. The gears run in oil and can be disengaged when the rear faceplate is not in use.

The speed controller is of the drum type and is mounted in the headstock leg. It is impossible to "jump" the machine into high speed without giving the motor an opportunity to accelerate properly for the safety of the operator. A notching device necessitates bringing the controller handle to the full stop position in order to stop the motor, the advantage of this being that the motor is always started on the low-speed winding.

Both the main and jack spindles run in ball bearings. The bed can be furnished in 6-, 8-, 10-, and 12-foot lengths. The tailstock is of a set-over design, and is equipped with a patented screw and lever feed. It has a swivel base which swings

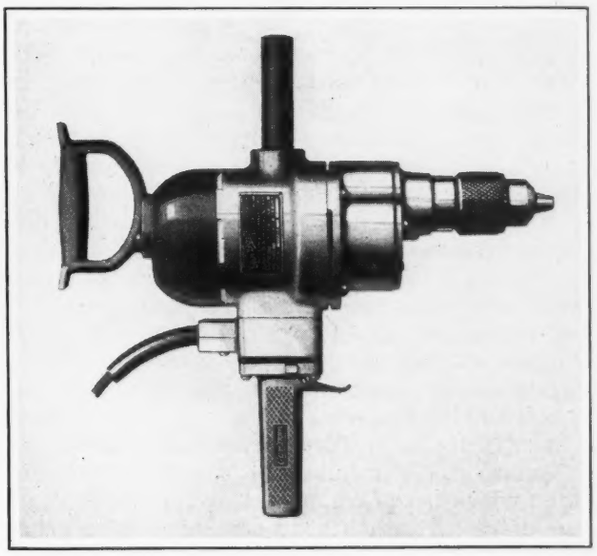


Blount Pattern-shop Lathe with Motor Headstock

through a full 360 degrees and is graduated so that any degree of taper may be bored or turned. The rated swing of this machine is 16 inches.

VAN DORN STANDARD PORTABLE ELECTRIC DRILL

A standard 1/2-inch portable electric drill now being introduced to the trade by the Van Dorn Electric Tool Co., Cleveland, Ohio, is particularly designed for maintenance work in factories and machine shops. In power, weight, and speed it is suited to the work of the millwright, plumber, electrician, and general repairman.



Van Dorn Portable Electric Drill of Improved Design

The motor operates on either alternating or direct current, and has a no-load speed of 540 revolutions per minute and a full-load speed of 300 revolutions per minute. The drill is equipped with a ball-bearing armature and an automatic safety switch. The drilling capacity is 1/2 inch in steel, while the weight is only 14 pounds and the over-all length, 15 3/8 inches. The drill is equipped with a combination spade and breastplate handle and a three-jaw screw-back chuck. It is furnished for current of 32, 110, 220, and 250 volts.

BROWN & SHARPE "STANDARD" MILLING MACHINES

Important new features of construction and operation which give simplicity of control and convenience of operation are embodied in a line of "Standard" milling machines now being introduced to the trade by the Brown & Sharpe Mfg. Co., Providence, R. I. Control features of particular interest include a single lever for speed changes (in two series); a single lever for feed changes at the front and rear of the table; direct-reading dials which indicate the rate of feed and speed engaged; a power fast travel in all three directions, which is gear-driven through a safety clutch; directional feed-engagement levers for all feeds, which are provided at the front and rear of the table; and a knee clamping arrangement operated from the front or rear of the table.

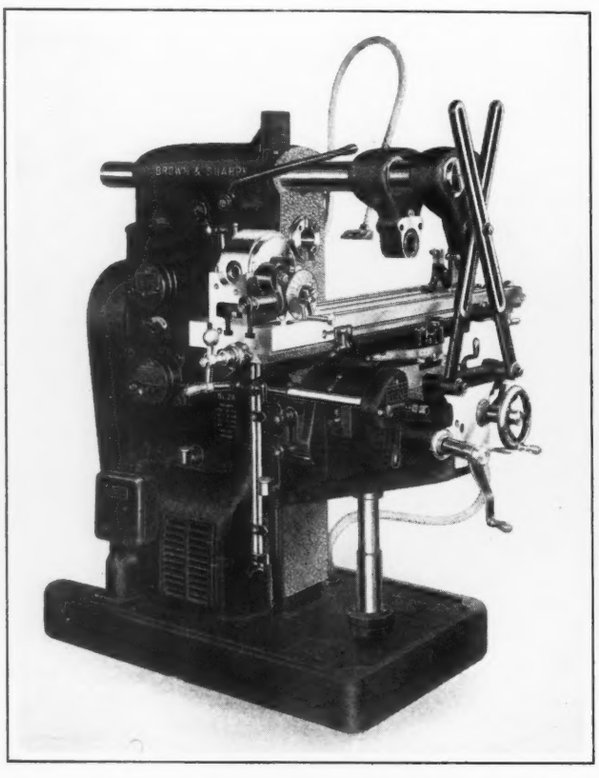


Fig. 1. Brown & Sharpe "Standard" Milling Machine with Dual Control

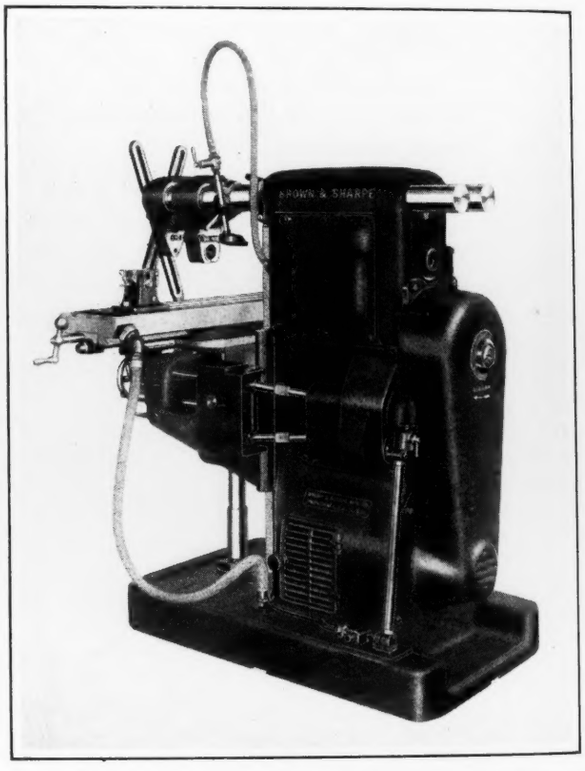


Fig. 2. Right-hand Side of Machine, Showing Construction for a Motor-in-base Drive

Constructional features consist of sliding gear feed and speed transmissions; a dry multiple-disk clutch which is self-compensating for wear; an all-gear drive through heat-treated alloy steel gears; anti-friction bearings for the feed, speed, and power fast travel transmissions and for the main drive pulley; and a one-piece knee screw which is completely guarded at all positions.

Lubrication features consist of a filter oil system which automatically lubricates all units in the column and the main drive mechanism; automatic lubrication of the knee mechanism by a pump; and lubrication of the saddle mechanism and table bearings from a single station.

One of the important features is the dual feed control, which permits the operator to make feed changes from either the front of the machine in the normal operating position or from the rear of the table when face-milling, boring, etc. Changes are made by a single lever, and the feed in use is shown on a direct-reading dial immediately above the control lever, only the actual feed in use being visible.

All control levers are readily reached from the two operating positions at the front or rear of the table, and they are always thrown in the direction of table movement. One revolution in either direction of a single lever on the left-hand side of the machine, gives a change in spindle speed. This lever is also equipped with a direct-reading dial which indicates the speed for which the machine is set. Two series of spindle speeds are available, the change from one series to the other being made by merely shifting the back-gear lever. The spindle reverse is controlled by a small handle just below the speed-change lever.

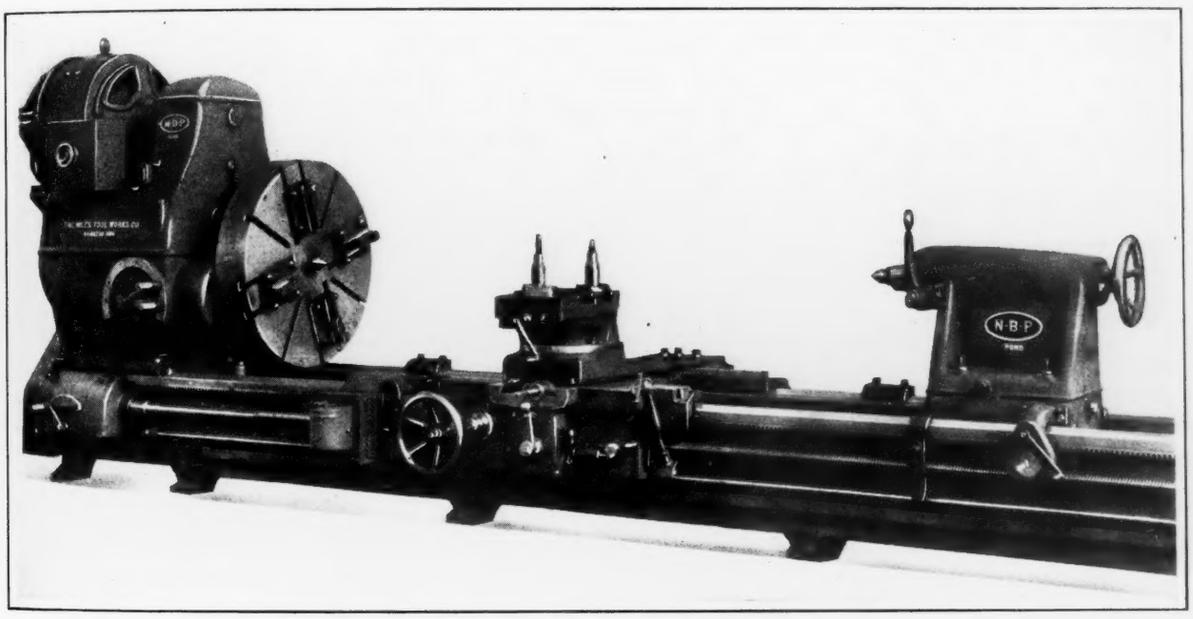
A gage indicates whether or not the pump is working to supply filtered oil to the units in the column and to the driving clutch. The inside of the column is coated with enamel to prevent any possibility of grit in the casting from getting into the lubricating system, while the complete enclosure of the column mechanism prevents the entrance of foreign matter. The cutter coolant system is de-

signed to provide either a flood supply or a thin stream. In either case, the coolant is delivered at a low pressure by a pump which is always immersed and which stops when the spindle stops.

Other features of the machine include the double over-arm, with convenient means for changing cutters; the standardized spindle end, which permits economy of cutter equipment; and the adaptability of the machine to a motor drive from the base compartment. These "Standard" milling machines are manufactured in the following sizes: Nos. 2A, 3A universal, and 2B, 3B plain.

NILES HEAVY ENGINE LATHE

A heavy engine lathe with many improved features has recently been brought out by the Niles Tool Works Co., Hamilton, Ohio. The particular machine illustrated has a rated swing of 42 inches, an actual swing of 43 inches, and a bed length of 32 feet, but it is typical in most respects of all sizes, from 36 to 60 inches swing. It is driven by a 20-horsepower variable-speed motor, but a motor of greater capacity may be used.



Niles Heavy Engine Lathe of Improved Design

The main-spindle bearing dimensions have been increased about 40 per cent, and other parts correspondingly. Four mechanical changes of speed are obtainable in the lower half of the headstock, with either an alternating- or direct-current drive. In conjunction with the variation in motor speeds with a direct-current drive, this gives faceplate speeds ranging from 1.9 to 231 revolutions per minute. With an alternating-current drive, the top half of the box has six additional mechanical changes, making twenty-four changes in all, ranging from 1.5 to 169.5 revolutions per minute.

Direct drive to the spindle is effected through a large gear pressed and keyed on it next to the front spindle bearing. All gears and bearings in the headstock are supplied with forced lubrication by an oil-pump driven from the driving gears. An indicator located in a prominent position shows the operator whether an ample supply of oil is being delivered to the headstock parts.

The spindle thrust bearing is in a separate unit outside the headstock. This enables it to be made of adequate proportions to carry the load, and permits ready access for inspection and adjustment. With a direct-current drive, the faceplate is quickly stopped by dynamic braking, but with an alternating-current drive, a mechanical brake is incorporated in the gear-box and operated from the motor control lever on the carriage. A jog button on the headstock permits of slightly turning over the gears while shifting and of "inching" the faceplate small amounts when setting up or inspecting work. The motor pinion shaft is supported between two bearings, independently of the armature shaft bearings, and so the motor bearings carry only loads induced by the motor itself.

The carriage is supported on the bed on V-ways, but the bridge also has a flat bearing on the inner edge of the front shear, thus giving a solid bearing directly under the tool. The carriage is clamped in position when cross-feeding. A graduated swiveling tool-slide with clamping bolts and tool straps is regularly furnished instead of the two poppet tool-holders shown.

Provision is made for a power angular feed, which may be supplied as an additional feature on the 36- and 42-inch lathes, but which is regular equipment on lathes of 48-inch swing and upward. Power rapid traverse to the carriage is also optional on the 36- and 42-inch sizes, and standard construction on larger sizes. A separate reversing motor for the rapid traverse is mounted on a bracket of the carriage and connected by gearing with the feed rack. The rack pinion may be withdrawn when cutting threads.

An oil reservoir in the top of the apron supplies oil to all gears and bearings through brass pipes. A lever on one side of the apron is operated to obtain either a cross or a longitudinal feed. The lever for engaging the lead-screw nut is interlocked with the feed. The feed gear-box provides four changes of feed and threads through sliding gears and clutches. Change-gears are furnished for additional feeds and threads.

GRIDLEY AUTOMATIC CHUCKING MACHINE

An automatic chucking machine especially intended for machining forgings such as those used for the inner and outer rings of ball and roller bearings and other work of similar character, has been designed and placed on the market by the Gridley Machine Co., Hartford, Conn. The machine has a capacity for machining work from 3 to 8 inches in diameter.

As seen in Fig. 2, the machine consists mainly of a rotating work-holding spindle, in the center of the machine, and two tool-slides of circular cross-section located one on each side of the work spindle, and with their centers in the same horizontal plane. The tool-slides—each provided with large-diameter cylindrical sliding surfaces giving very large bearing areas—have two movements; one swinging movement about the center of the tool-slide for bringing the tools into their working positions, and for swinging them out of the way when chucking or removing the work; and the other movement, a forward and return movement for feeding the tools during the cut and returning them when the cut is finished. The work is clamped in the chuck by a combination of hydraulic and pneumatic clamping means, which is a special feature of the design. The entire cycle of operation is automatic—from the time the operator places the work in the chuck and presses the push-button switch which operates the hydraulic chucking mechanism, until he unclamps and removes the work.

The Main Drive of the Machine

The main drive of the machine is from a motor built into the base, as shown in Fig. 4, through a chain drive to the upper sprocket shown in the same illustration, from which the work spindle is driven by means of a worm and worm gear. Different spindle speeds are obtained by changing the size of the sprockets used. The idler to the left permits of adjusting the chain for different sizes of sprockets. The sprocket to the right drives the so-called "high-speed" movement of the camshafts that control the tool-slides—the rapid movement of the slides when the tools are not cutting. This high-speed movement of the tool-slides is at a constant speed no matter what may be the feed of the cutting tools when in action.

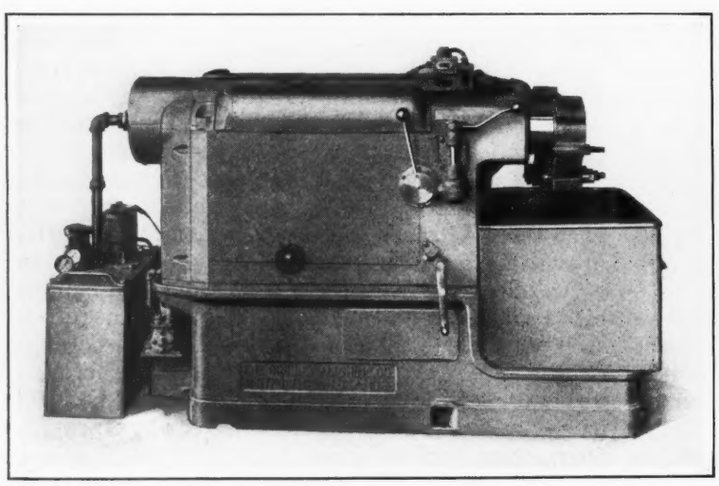


Fig. 1. Front View of Gridley Automatic Chucking Machine

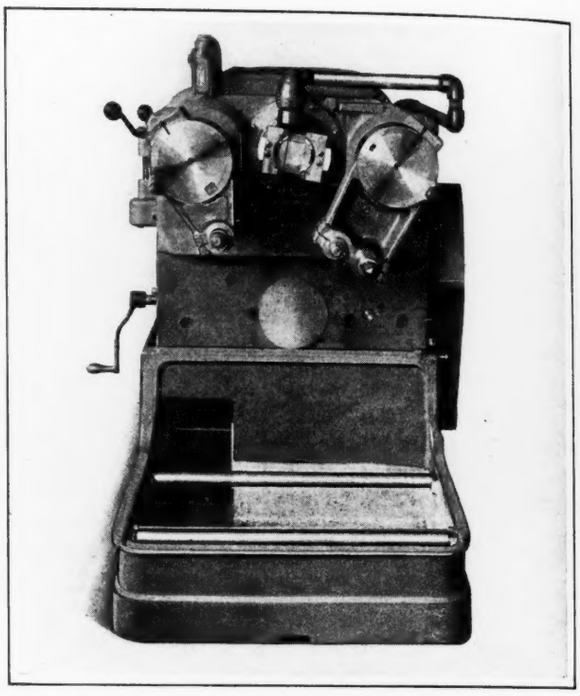


Fig. 2. View Showing Ends of Tool Slides and the Work Spindle, the Chip Pan Being Removed

When the tools are cutting, the camshaft is driven directly from the work spindle through the change gears shown at the end of the machine in Fig. 3, different speeds being obtainable by changing the gears. Automatically-operated clutches are provided which change the camshaft speed from the high-speed to the feed movement, and a clutch is also provided for operating the camshaft by hand through a lever shown on the front of the machine in Fig. 1. The work spindle can also be disengaged and stopped at any time by a hand-operated lever. All the clutches used throughout the machine are of the multiple-disk type.

The Operation of the Tool-slides

Assume that the tool-slides are in the position shown in Fig. 2. The mechanism through which the tool-slides are operated is shown in Fig. 4, where the cover plates over the slide-operating mechanism and the motor, as well as the guard over the chain and sprockets, are removed. The mechanism for operating the tool-slides is duplicated on each side of the machine, being identical in design for both slides. A large gear will be seen mounted on the tool-slide. This engages with a segment gear which is mounted on the camshaft immediately below. The other end of the segment gear extends downward and is provided with a roller which is actuated by a cam by means of which movement is transmitted through the segment gear and the gear on the tool-slide, so that the latter may be swung into the operating position. At the moment that the tool-slide is in this position, the drum cam shown comes into action and moves the tools longitudinally with relation to the work. In this way the tools are located in the cutting position.

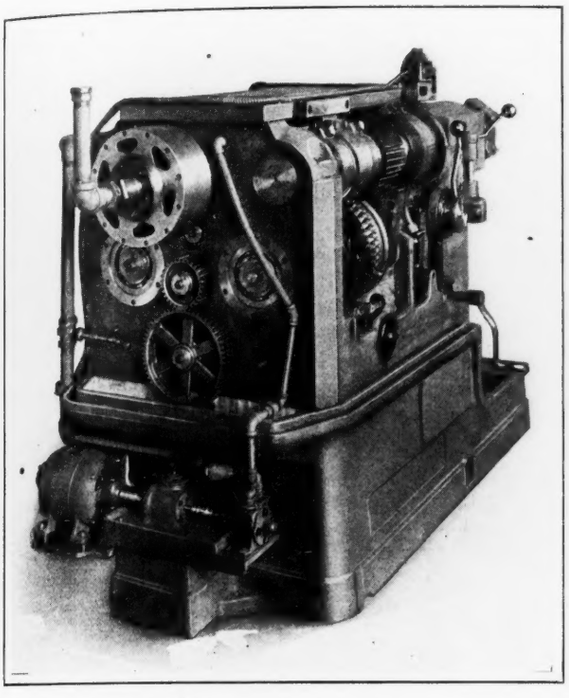


Fig. 3. Rear End View Showing the Change Gears and the Motor for the Lubricant Pumps

On the left-hand side of the segment gear, as shown in Fig. 4, an arm is mounted on the tool-slide which, when the drum cam has moved the slide over, comes into contact with a plain cylindrical guide through which the tool is maintained in the exact position with relation to the work while in operation. For straight turning, this guide is a plain cylinder, but for forming or facing work, it is provided with the necessary radial cam surface for moving the tool laterally with reference to the work.

The Chuck-operating Mechanism

The chuck is opened by a push-button control at the top of the machine in Fig. 1, which through a solenoid operates a valve in the pneumatic-hydraulic unit shown to the extreme left in Fig. 1. As soon as pressure is removed from the button, the chuck closes. Through the special design of this unit, use is made both of pneumatic and hydraulic pressure, the former supplying a quick movement up to the point where the chuck is ready to grip, and the latter the actual gripping pressure. The action, in fact, is somewhat similar to the quick high-speed movement of the tool-slide and the slow feeding movement, as operated through the camshaft. By this combination of pneumatic and hydraulic action, the full pressure of the oil pump is always available for holding the work in the chuck. The pressures obtainable can be varied by adjusting two valves, and pressures from nothing up to the maximum may be obtained.

The power for the hydraulic chuck operating unit is supplied by a 1/4-horsepower motor, which represents an appreciable saving of power. The hydraulic unit is self-contained and can easily be applied to existing equipment, as well as to new installations, without requiring any piping in connection with existing power equipment.

Provision for Lubrication, Cutting Lubricant and Chips

All bearings except those of the tool-slides are ball bearings. Lubricating oil is provided by a separate oil pump, as shown in Fig. 3, with leads to the main bearings and splash lubrication for the gears. In fact, the entire inside of the machine is continuously splashed with oil so that the entire mechanism is practically running in an oil bath. The pump for the lubricant and the pump for the cutting oil, which is also located at the rear of the machine, are driven by a separate motor, as shown. The handle which operates the spindle clutch for throwing out the power to the spindle whenever it is desired to stop the work by hand, also cuts off the supply of cutting lubricant.

One of the features of the machine is the method used for taking care of the chips. It will be noted that the machine is so designed that there are no slides or working surfaces below the chucking end, so that chips cannot fall on any working surface and cause damage. As shown, a large chip pan is placed at the front end of the machine, into which the chips may fall without any obstruction. The chip pan is provided with a perforated screen located about 1 inch above the bottom of the pan so that the oil can drain freely from the chips, after which it runs out through an opening of the chip pan next to the machine. Practically the entire base of the machine is an oil reservoir. The oil is thus kept away from the chips and has an opportunity to cool.

The chip pan can be easily removed by sliding it out on to a truck, and another chip pan can be put in its place, thereby saving a great deal of the time often required for cleaning out the chips when these fall on the working parts and between the members of a machine. As indicated in Fig. 2, the chip pan rests on rollers which facilitates its removal even when filled with heavy chips.

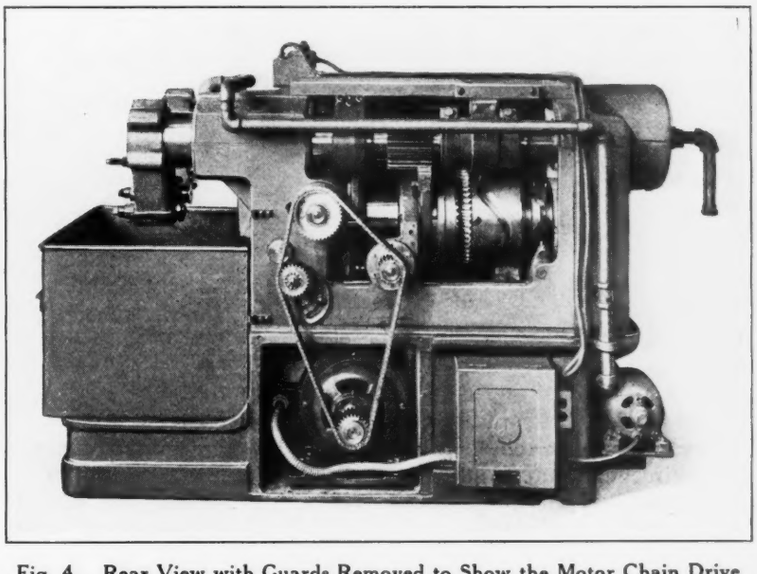
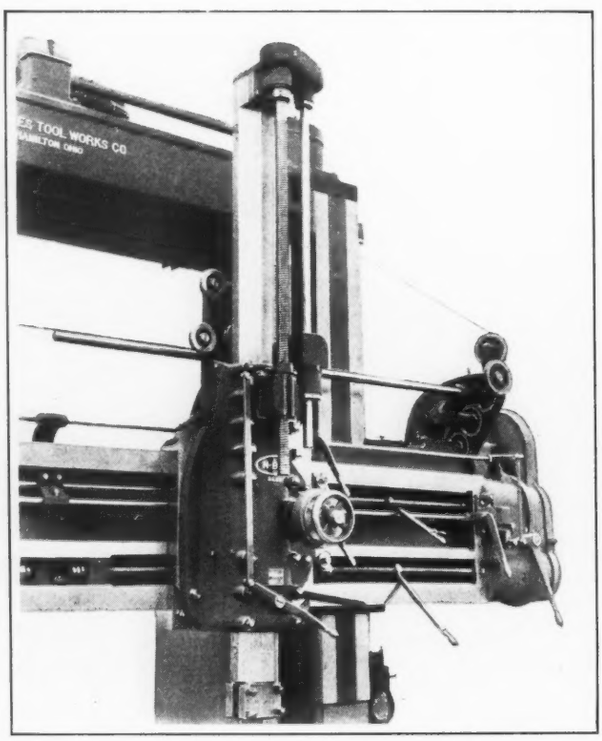


Fig. 4. Rear View with Guards Removed to Show the Motor Chain Drive and Cam Mechanism

NILES BORING AND TURNING MILL

A 12-foot boring and turning mill recently brought out by the Niles Tool Works Co., Hamilton, Ohio, closely follows the design of the 18-foot and 20-foot boring and turning mills described in MACHINERY for May, 1927, and November, 1927, respectively. It embodies, in general, the same features, such as double table tracks with pressure lubrication; sliding-gear feed-boxes with the gears running in oil; a box-section cross-rail with a bearing on the face of the housings and extending back between the housings as well; separate motors at the back of the rail for the rapid traverse of the bars and saddles; direct-reading micrometer dials for the saddle and bar movements; a limit switch for the elevation of the cross-rail; a totally enclosed drive box with all-steel gears and pressure lubrication; a steel table gear; and fully enclosed rail elevating gears on the top brace.

In addition, the right-hand head of the smaller machine is equipped with a thread chasing attachment of the lead-screw type. This attachment is shown in Fig. 2 and gives leads up to 2 inches. The machine is driven by a 35-horsepower direct-current, 4-to-1 variable-speed motor, giving table speeds ranging from 0.56 to 10.8 revolutions per minute. A 7 1/2-horsepower motor is employed for elevating the cross-rail and two 5-horsepower motors, one for each head, produce the rapid traverse of the saddles and bars. A 1/2-horsepower motor drives the oil-pump.

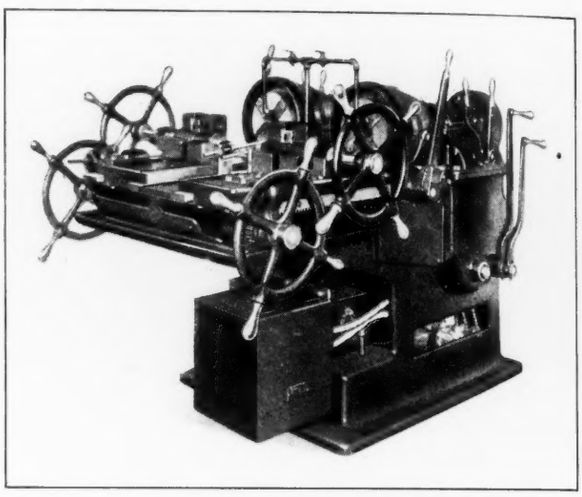


Thread-chasing Attachment on Niles Boring Mill

The regular feed and traverse movements of the bars and saddles are obtained through large friction clutches housed at the ends of the rail, but for the chasing mechanism, the motion is positive through an additional train of shafts and gears. Half-nuts closed by means of a lever at the base of the saddle engage the threads of the chasing attachment. A handwheel on the saddle releases the bar rack pinion when the chasing attachment is in use. Three leads are furnished, but these may be varied by the introduction of additional gear ratios.

WILLIAMS DOUBLE-HEAD BOLT THREADER

A double-head bolt threader which combines, in a single compact unit, two "Rapiduction" 1 1/2- and 2-inch machines, is a recent development of the Williams Tool Corporation, Erie, Pa. One of the features is a dual control, which gives complete control of the machine from either side. There are eight spindle speeds for each head. The single-head "Rapiduction" machine was described in February, 1927, MACHINERY. Threads from 3/8 to 1 1/2 inches can be cut with one head of the new double-head machine, and from 1/2 to 2 inches, with the other head. In cutting long threads, the operator runs both sides of the machine at the same time. Another important saving is derived from the double-head machine in the set-up time when two different sizes of bolts are run through together with frequent changes from one size to the other.



Williams Double-head Bolt Threader with Dual Control

The machine is driven by a motor, located in the base where it is out of the way of chips and dirt. The motor is mounted on an adjustable base which enables the operator to keep the driving chain tight. The driving gears run in oil, and high-pressure lubrication is supplied to the die-heads.

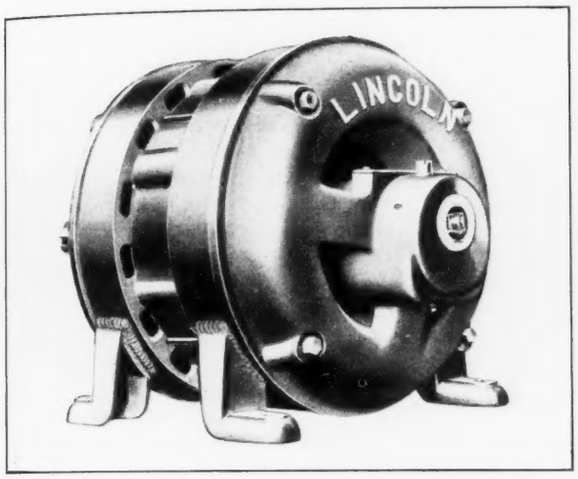
Automatic compression springs open and close the dies, and the heads are adjusted to the size of bolt to be cut by pulling the control lever forward. The heads are released automatically after each threading job, by trip-rods. Either die-head can be readily disengaged without shutting down the machine. The dies of each head can be removed and changed in a few seconds without removing the large die-holders.

"LINC-WELD SWITCH START" MOTOR

A "Switch Start" motor for which several advantages are claimed is built by the Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio, in sizes of from 1/2 to 30 horsepower for either two- or three-phase sixty-cycle current. This motor is so designed that it can be started directly across

the line without the use of a starting compensator, starting resistance, or other voltage reducing mechanism, with starting current below the requirements of the National Electric Light Association.

The chief claim for the new motor is that operating characteristics such as power factor, efficiency, maximum torque, temperature rise, etc., have not been sacrificed in order to secure low starting currents. Tests have shown that starting torques of from full load to more than 250 per cent of full load, depending on the horsepower and



Lincoln "Switch Start" Motor of Welded Steel Construction

speed, are possible without exceeding the N.E.L.A. requirements as to starting currents.

It is claimed that the motor will not stall on sudden high overloads. It is of the "Linc-Weld" welded-steel construction and is normally equipped with sleeve bearings, although ball bearings may be furnished.

GENERAL ELECTRIC PORTABLE TINNING POT

A portable RP form C melting pot intended for use in small tinning and soldering operations, has been brought out by the General Electric Co., Schenectady, N. Y. It is built on the same principle as the larger melting pots manufactured by the same company. The heating unit is of the cartridge type and dissipates 150 watts. It is placed in a boss cast on the bottom of the crucible and is readily removable. The crucible and base are made of cast iron and the jacket, of sheet steel.

This pot has a maximum operating temperature of 500 degrees F. About 15 minutes is required to reduce the full contents of the pot to the working temperature. The pot is 2 1/2 inches in diameter and 1 inch deep, inside, and 5 inches in diameter and 4 1/2 inches deep, outside.

BECKER VERTICAL MILLING AND DIE-SINKING MACHINE

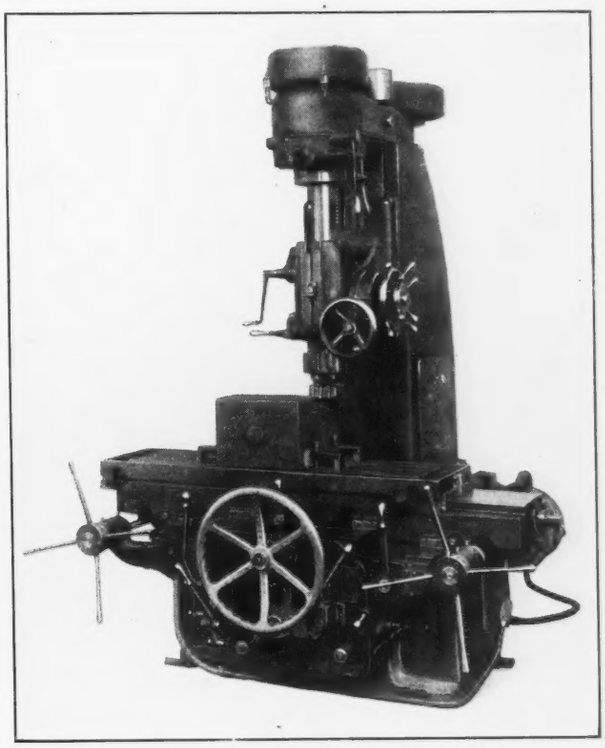
A model No. 5 Becker vertical milling and die-sinking machine is the latest addition to the line of machine tool equipment built by the Reed-Prentice Corporation, Worcester, Mass. This machine, like the larger No. 6 model, was developed for the vertical milling of big heavy castings and for the machining of drop-forge and body dies, etc.

Features of the new machine include a Timken roller-bearing construction throughout, seventy Timken bearings being used in the speed, feed, and top gear-boxes and in the main spindle bearing. The high spindle speeds required in using end-mills and die-sinkers' cutters are obtained through a belt drive to the spindle. The machine has an unusual range, with a rapid power traverse, longitudinally and crosswise in either direction, at the rate of 100 inches per minute.

Eighteen spindle speeds ranging from 16.9 to 600 revolutions per minute are available. There are eight feeds for each spindle speed, ranging from 0.002 to 0.297 inch per spindle revolution. The spindle is provided with a micrometer stop-gage for accurately controlling the depth of cut. It has a clutch-type nose and the new taper hole adopted by the National Machine Tool Builders' Association.

Either a single-pulley belt drive or a direct belt-connected motor drive is regularly provided. A motor of 7 1/2 horsepower, running at 1200 revolutions per minute, is recommended. The main drive pulley runs at 600 revolutions per minute, and is supplied with a clutch and brake that are controlled through one lever located at the front of the machine.

Centralized control is another feature of the machine, all speed and feed levers being located at



Becker Vertical Milling and Die-sinking Machine

the front for convenient operation. Large-diameter handwheels can be supplied in place of pilot wheels for feeding the table longitudinally by hand. The pilot wheels are automatically disconnected when the power feed is being used. The head and spindle are counterweighted to insure easy adjustment.

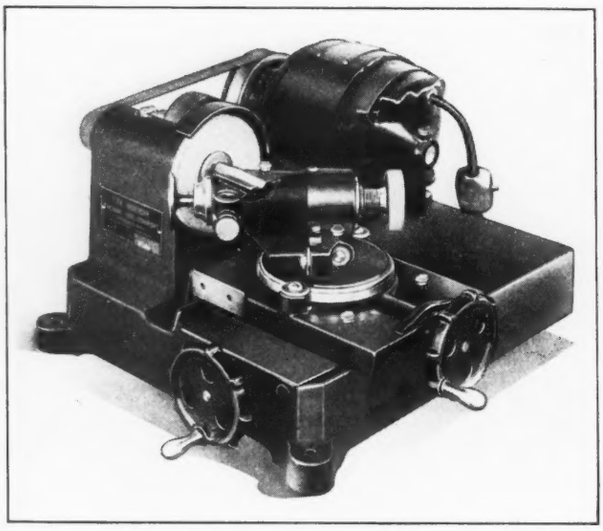
Some of the important specifications of the machine are as follows: Working surface of table, 62 by 16 inches; longitudinal travel of table, 48 inches; cross travel of table, 16 inches; minimum and maxi-

mum distances from spindle nose to table, 0 and 24 inches, respectively; vertical feed of spindle, 9 inches; travel of head on column, 15 inches; throat depth, 20 inches; and distance between center line of spindle and face of column, 11 1/4 inches.

VAN NORMAN VALVE REFACER

A model F valve refacer recently developed by the Van Norman Machine Tool Co., 150-200 Wilbraham Ave., Springfield, Mass., is being placed on the market by the Van Dorn Electric Tool Co., Cleveland, Ohio. This machine employs a chucking method in which a double-grip collet secures the valve at two places three inches apart on the stem, with a six-point simultaneous contact. This method holds the valve in true alignment while being refaced. All contact points are hardened and ground. The double-grip collet has a range for stems of from 5/16 to 1/2 inch in diameter. The construction is simple, no adjustments being necessary for maintaining alignment.

Valves with heads up to 4 1/2 inches in diameter can be refaced to any angle from 30 to 50 degrees.

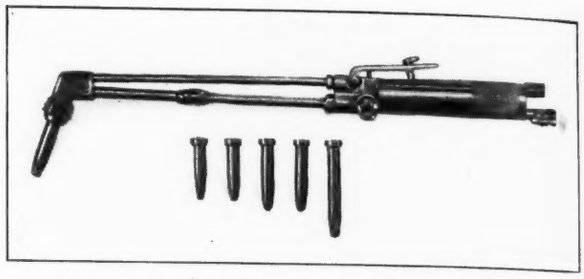


Van Norman Valve Refacer Marketed by the Van Dorn Electric Tool Co.

The wheel-head is of full ball-bearing construction. One belt delivers power from the motor to both the wheel-head and the work-head. The work-head has a smooth drive through a flexible shaft, and worm and worm gear. The motor is of a heavy-duty high-torque type which operates at a constant speed.

The work-head is graduated for settings at 30, 40, 45 and 50 degrees. Smooth-running adjustable sleeve-type bearings are used in the work-head. The slides are permanently adjusted for proper tension and are protected against grinding dust. The valve is fed to the wheel by using two hand-operated screws. A V-block on top of the work-head makes it possible to resurface the tappet end of valve stems.

This valve refacer is equipped with a diamond pointed tool for accurately dressing both the side and face of the grinding wheel. Valve reseating tools can also be sharpened on the machine. A special attachment may be furnished for grinding rocker arms.



Milburn Combination Cutting and Welding Torch

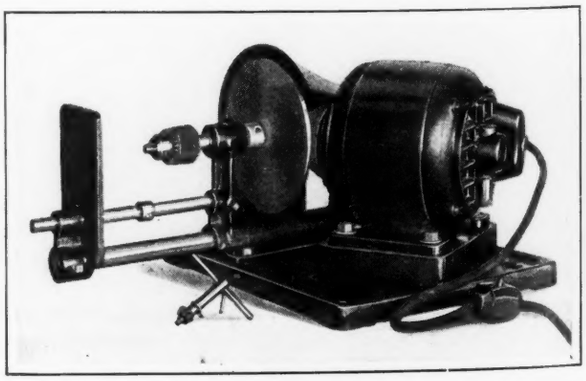
MILBURN COMBINATION CUTTING AND WELDING TORCH

A type RI combination cutting and welding torch, which operates on high-pressure gas only and cuts or welds by the mere interchange of tips, is a recent product of the Alexander Milburn Co., Baltimore, Md. The torch is made to operate with oxygen and acetylene, oxygen and hydrogen, or other gases. It obviates the necessity of using two torches and of disconnecting the hose from the torch valves when changing from cutting to welding operations or vice versa. The torch is light in weight, weighing only 40 ounces, which is especially advantageous to the operator when the torch is used for continuous work. The torch may be employed for welding the lightest or heaviest metals and cuts metal 12 inches in thickness or more.

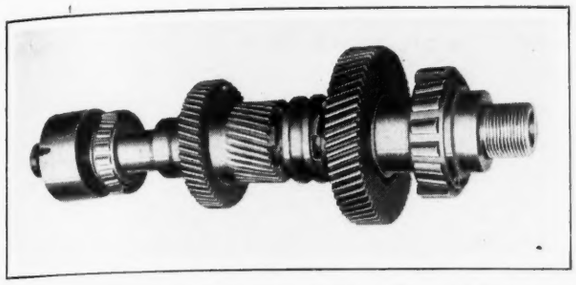
ALTO HIGH-SPEED TAPPING MACHINE

Holes up to 5/16 inch can be tapped in brass and up to No. 8-32 in steel with a No. 1-A motor-driven high-speed tapping machine built by the Alto Mfg. Co., 1647-51 Wolfram St., Chicago, Ill. With the motor running at 1725 revolutions per minute, the forward speed of the tap is 875 revolutions per minute, and the reverse speed, 1750 revolutions per minute. A cone friction drive enables the operator to tap to the bottom of a hole without danger of breaking the tap. Reversal of the spindle is accomplished without a hammering action. Power can be taken from a light socket.

In operation, the work is put on the faceplate and merely pushed against the tap. This engages the driving cone, and causes the tap to be fed into the work. When the hole has been tapped to the proper depth, which may be governed by the depth stop, the operator pulls slightly on the work to engage the reversing cone for backing out the tap. Work-holding fixtures may be fastened to the faceplate. The weight of the equipment, complete with the motor, is 53 pounds.



Alto Motor-driven High-speed Tapping Machine



Monarch Lathe Spindle with Timken Tapered Roller Bearings

MONARCH LATHE SPINDLES WITH TIMKEN ROLLER BEARINGS

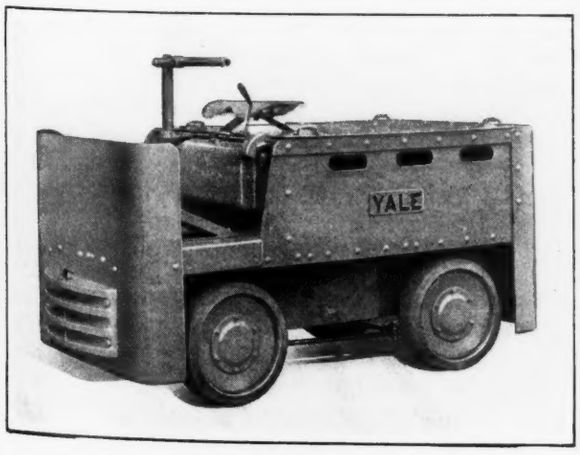
Spindles equipped with precision-type Timken tapered roller bearings are now furnished in the helical geared-head lathes from 14- to 30-inch in size which are built by the Monarch Machine Tool Co., Sidney, Ohio. These bearings are made to within limits of 0.0002 inch and insure accurate spindle alignment indefinitely.

All end thrust of the spindle is taken against the front bearing. In fact, in mounting the bearings, an initial thrust load is imposed, thereby removing all radial as well as end movement of the spindle. Adjustment of the bearings is provided for, but only infrequent adjustment should be necessary. It is claimed that because of these roller bearings, heavier cuts can be taken without chatter or vibration than was possible with the previous plain bearings. Other features of the roller bearings pointed out are the ease with which the bearings can be replaced and the elimination of spindle wear. Clean filtered oil is supplied to both bearings.

YALE TRACTOR WITH FOUR-WHEEL DRIVE

A model K24C tractor having a four-wheel drive has been brought out by the Yale & Towne Mfg. Co., Stamford, Conn. This tractor is capable of exerting an ultimate draw-bar pull in excess of 4000 pounds and will operate at a continuous draw-bar pull of 1000 pounds without overheating. Maximum traction with the given weight is claimed to be one of the features derived from the four-wheel drive. The brakes operate through the differentials and equalize, regardless of lining conditions.

The brake foot-pedal is made large enough to permit both feet of the operator to rest on it. To apply the brakes, the foot-pedal is allowed to rise. This not only automatically applies the brakes, but also opens the cut-out switch in the controller. Should the operator at any time leave the tractor or fall from it by accident, the brakes would automatically come into action. Steering is accomplished through a lever handle so arranged that it may be folded out of the way when the operator wishes to leave his seat.

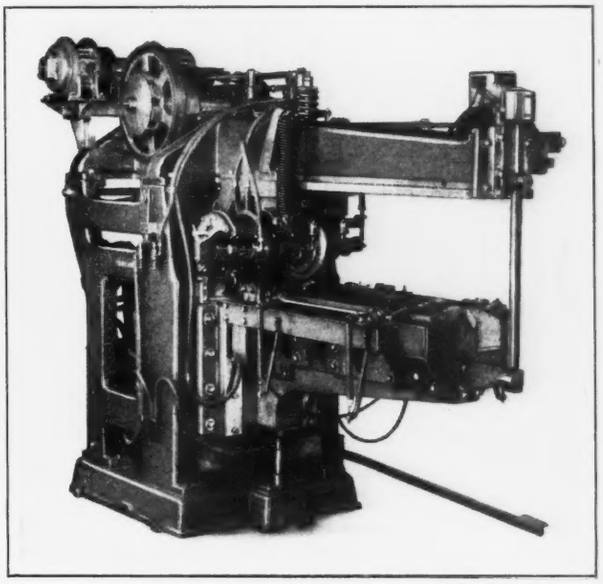


Yale Tractor with Four-wheel Drive

Two standardized driving units are connected in parallel at the controller. The employment of standard units permits interchangeability by the customer. It is possible to interchange the drive units with those of any industrial truck in the Yale K line. This tractor is regularly furnished with a 48-volt motor and a 23-to-1 gear ratio.

THOMSON ELECTRIC SEAM WELDER

A model 436 heavy-duty seam welder of a fixed lower-horn traveling-roller type, designed especially for lap-seam welding steel barrels or drums, is the latest machine to be produced by the Thomson Electric Welding Co., Lynn, Mass. This machine



Thomson Heavy-duty Seam Welder

can be furnished with or without a jigging arrangement and with different jigging methods to meet individual requirements. The welder has a capacity for handling two pieces of material up to No. 16 gage. Pressure-tight welds can be made on full-finished sheets without extra preparation, but scaly stock must first be ground on the edges or cleaned by some other process.

The maximum stroke of the roller carriage is 40 inches, but for high production, the actual length of material that can be handled is 36 inches. The transformer has a rating of 100 kilowatts, 175 kilovolt amperes. Five points of heat can be secured through the regulator mounted at the rear of the welder. This amount of regulation is sufficient for all classes of material within the range of the machine. When it is necessary to secure heat regulation between the points taken care of in the welder transformer primary, the result can be accomplished by adjusting a pressure spring or the speed of roller travel. Uniform heat is obtained

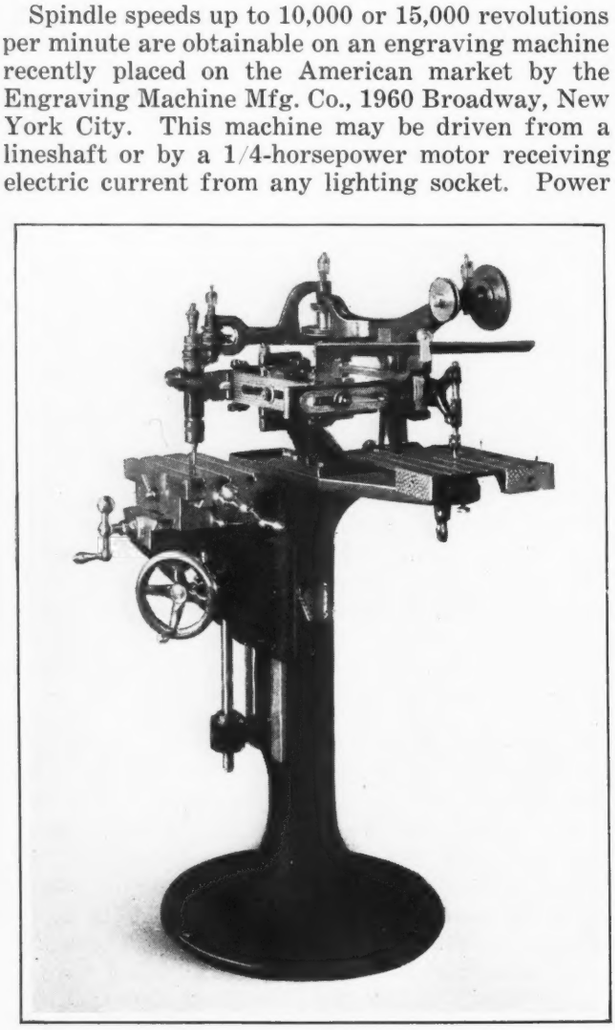
for the full length of the seam to be welded through a secondary lead construction of special design.

The welding speed is from 10 to 40 feet per minute. Driving of the roller carriage is accomplished by means of a rack and pinion mechanism driven by a one-horsepower motor through a Reeves variable-speed drive, this method permitting accurate speed adjustment. The lower die is a bar copper insert made of 1 1/2- by 1/2-inch hard-drawn copper. It is narrow enough to file without removing the die from the welder, and can easily be shimmed when filed down to the point where this is necessary. The traveling roller die is 12 inches in diameter by 1 1/2 inches thick, and is clamped against a water-cooled mandrel. The design of the upper roller permits speedy removal of the roller die, it being possible to change this die in less than ten minutes. It is estimated that the roller die will make approximately 1000 welds on 55-gallon drums before removal is required.

The illustration shows the machine equipped with a magnetic chuck for holding barrels or shells during the welding operation. Depending upon the system of holding work, it is estimated by the manufacturer that from 80 to 120 fifty-five-gallon drums can be welded per hour. The machine weighs approximately 11,200 pounds.

HIGH-SPEED ENGRAVING MACHINE

Spindle speeds up to 10,000 or 15,000 revolutions per minute are obtainable on an engraving machine recently placed on the American market by the Engraving Machine Mfg. Co., 1960 Broadway, New York City. This machine may be driven from a lineshaft or by a 1/4-horsepower motor receiving electric current from any lighting socket. Power is delivered from the motor to the spindle through three separate round leather belts in a manner which eliminates all motor vibrations on the spindle. Another feature is that the work surface being engraved is always approximately on the same horizontal plane as the pattern traced by the pantograph stylus. Because of this and the fact that there is no overhead support for the spindle, the operator can clearly observe the work. The machine may be employed for engraving the hardest steel, brass, aluminum, bakelite, glass, marble, etc.



Machine Built by the Engraving Machine Mfg. Co.

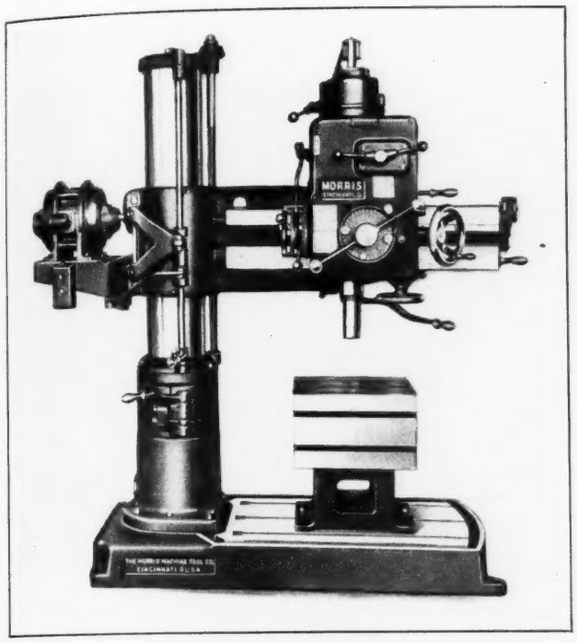
Reductions from 15 to 1 can be made to such a degree that words or letters are not legible to the naked eye. In changing from one reduction to another, three adjustments are made in which slides are moved along arms of the pantograph mechanism. These arms are graduated in inches or millimeters to facilitate settings. Adjustments of the slides are quickly accomplished by turning knurled collars to actuate small pinions which engage racks on the pantograph arms. By properly setting the slides of the pantograph arms, letters or other devices of longer or wider proportions than those of the pattern, can be produced. Movements of the pantograph mechanism in following a pattern are performed with ease, due to the absence of any considerable weight on the spindle. A micrometer device permits of accurately raising or lowering the spindle to change the depth of cut. Engraving tools with shanks 3 inches long are employed, and these tools are made in about twenty-five different styles for every kind of engraving.

Various attachments may be furnished, including a cutter grinder, which is bolted to the pantograph table and driven direct from the motor or lineshaft used to drive the machine. The cutter is held horizontally for grinding, and turned one-half a revolution against a wheel having an angular face. Another attachment consists of a universal work-holding chuck which may be swiveled horizontally about a complete circle and also any amount from horizontal to vertical. An indexing table can be furnished for circular work, and there is also a small vise which may be adjusted from horizontal to vertical.

MORRIS RADIAL DRILLING MACHINE WITH TIMKEN BEARINGS

A high-speed, all-geared radial drilling machine has recently been added to the line built by the Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio, which is equipped with Timken tapered roller bearings throughout, with the exception of the bearings for the bevel gears of the tapping attachment. The latter are double-row ball bearings. This radial drilling machine is built in 3- and 4-foot sizes, and has a capacity for driving up to 1 1/2-inch drills. All speed and feed changes are made in the head through centrally located levers. Twelve speeds, ranging from 125 to 1600 revolutions per minute, and six feeds, ranging from 0.004 to 0.025 inch per spindle revolution are available.

All gears, including those of the tapping attachment, are made of alloy steel and are hardened and ground. Sliding gears have six broached keyways. The spindle and all shafts are heat-treated and



Morris Radial Drilling Machine of Improved Design

multiple-splined. The tapping-attachment reverse clutch is of a new design of the multiple-disk type, with the metal disks running in oil.

Moving parts of the head and back bracket also run in oil. A pump operated at constant speed forces the oil through a sight-feed oiler on top of the head, from which it feeds by gravity. The spindle is mounted on roller bearings in a heat-treated steel sleeve. A dial depth gage, automatic feed trip, and safety friction feed are incorporated in the head.

A lever conveniently located at the front of the machine controls the elevating, lowering, and clamping of the arm. This lever unclamps the arm automatically before throwing in the elevating device. It is not necessary to change the spindle speed or stop the motor before moving the arm. A safety friction device on the elevating screw and automatic knock-outs at the top and bottom of the column prevent any damage should the operator run the arm to the extreme limits. The entire machine, including the elevating device, is operated by a constant-speed motor mounted on the arm and geared direct to the drive shaft.

BILLINGS AND SPENCER "KLOSE-KWARTER" WRENCH

A wrench especially designed for use on nuts that are hard to get at is being manufactured by the Billings & Spencer Co., Hartford, Conn., under the trade name of "Klose-Kwarter." This is a double-headed wrench with the openings at a 75-degree angle. The jaws are narrow and pointed and the heads are unusually thin. Both heads are on the same side of the wrench, so as to afford a comfortable grip and maximum leverage.

This new wrench is made for all popular sizes of S. A. E. and U. S. standard nuts. For the automobile trade, five wrenches are packed in a kit to give an assortment of ten openings varying from 3/8 to 7/8 inch. The wrench is drop-forged from chrome-molybdenum steel.

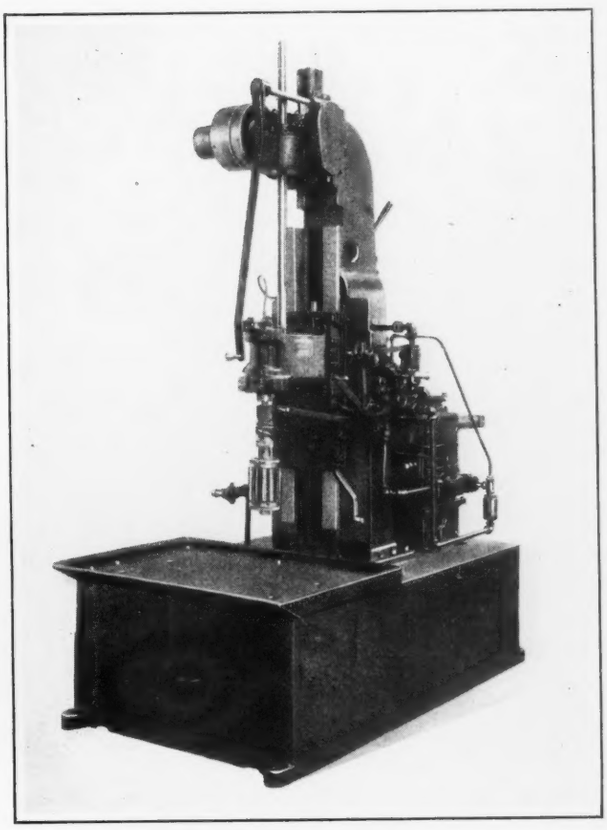
MOLINE SINGLE-SPINDLE LAPPING MACHINE

A No. 12 single-spindle lapping machine designed for use in shops where production requirements do not warrant the installation of a multiple-spindle machine, has been brought out by the Moline Tool Co., Moline, Ill. This machine is also intended for use in corrective lapping. The automatic features of the Moline multiple-spindle lapping machine described in December, 1926, MACHINERY, by means of which the spindle makes a predetermined number of strokes and then withdraws and stops, are not always essential nor desirable on a single-spindle machine. For this reason, the new machine is furnished with or without automatic control. The illustration shows the non-automatic machine.

The base is used for a reservoir and settling tank, having a capacity of about two barrels. A pump which can deliver thirty gallons per minute keeps a steady flow of compound on the lapping tool. The compound drains into two drawers, which can be easily removed for cleaning, overflowing from these drawers into the first compartment of the base and then over baffle plates into successive compartments until the last one is reached, from which it is repumped to the lapping tool. By this method, grit and dirt settles before the liquid is used again.

The drive can be either from a motor or countershaft to the clutch pulley on the machine, from which power is transmitted to the spindle through spiral and spur gears. The multiple-disk clutch is operated by a lever, which also controls a brake to stop the spindle rotation instantly as the clutch is disengaged.

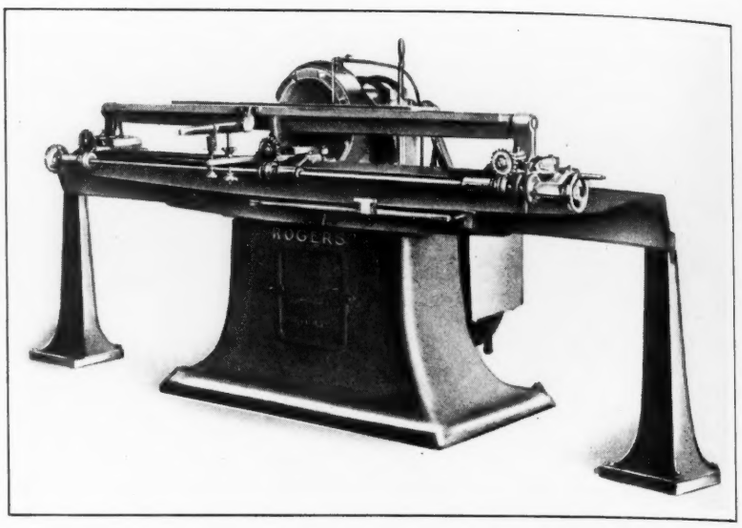
Reciprocation of the spindle slide is accomplished through an Oilgear pump and cylinder, which are controlled by levers at the front of the machine.



Moline Single-spindle Hydraulic Lapping Machine

The stroke can be set for any length up to 24 inches, and the rate of reciprocation can be changed by adjusting a valve on the Oilgear pump. All reciprocating parts, such as the rail, slide, and heads, are made of aluminum so as to have minimum weight. The slide can be set to give a maximum distance of 47 inches between the spindle nose and the table.

The machine is equipped with a one-shot centralized oiling system, operated through a lever. A motor running at 1200 revolutions per minute, of from 5 to 7 1/2 horsepower, is recommended. The working surface of the pan table measures 35 by 45 inches.



Rogers Heavy-duty Sectional-wheel Knife Grinder

A. F. K. VISE WORK-SUPPORT

A work-support designed to increase the holding and gripping power of bench vises, especially for handling work of irregular shape having only small gripping surfaces, has been brought out by the A. F. K. Fountain Works, 375 Reed St., Milwaukee, Wis. With this support, the work is gripped in the usual manner, but without undue force, as any overhang of the work can rest on the support.

The support is adjustable to permit its application to vises having jaws of different lengths or thicknesses. It is quickly attached to a vise or removed. In attaching the support, it is important to have enough play to the automatic spring adjustment so that the support will accommodate itself to the opening and closing of the vise jaws. The corrugated adjustable clamps are malleable-iron castings, while the torsion springs are made of piano wire. The support is casehardened.

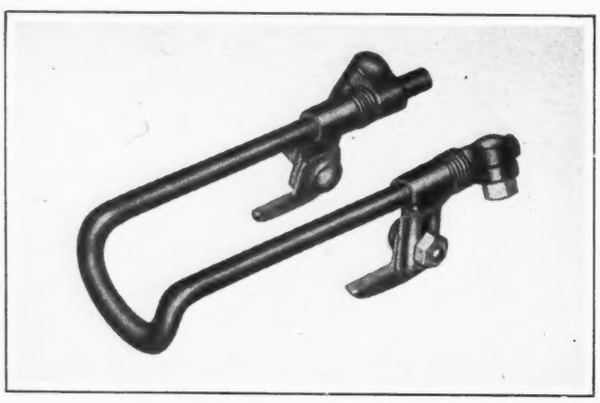


Fig. 1. Construction of A. F. K. Vise Work-support

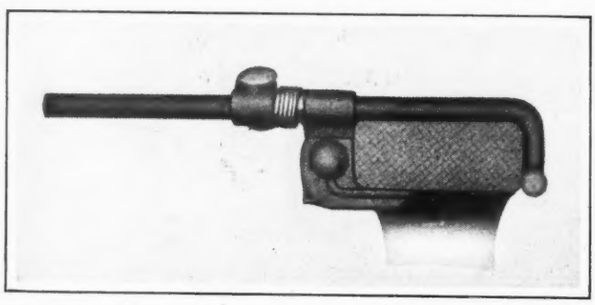


Fig. 2. Method of Attaching the Vise Work-support

ROGERS AUTOMATIC SECTIONAL-WHEEL KNIFE GRINDER

A type R heavy-duty machine for grinding shear, paper, chipper, and veneer blades up to 146 inches long has been developed by Samuel C. Rogers & Co., 191-205 Dutton Ave., Buffalo, N. Y. This machine is equipped with a 14-inch wheel made up of eight segments. The segments are mounted in a steel chuck provided with means for securely holding and easily replacing the segments. It is claimed that the wheel permits fast grinding of knives without "burning" them.

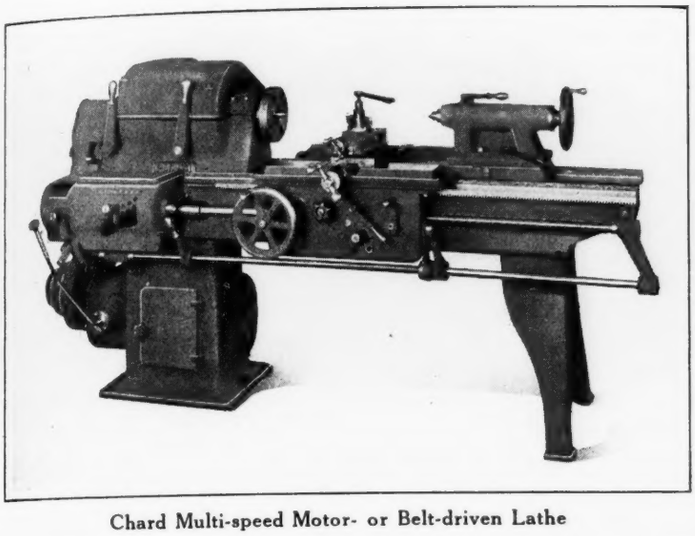
The machine is also equipped with an improved water attachment and a spring cross-feed. The heavy yoke bottom supports are provided with a nut, which is adjustable to eliminate vibration. An automatic stop is furnished for the double ratchet feed. A ball-bearing design of machine can be furnished if desired. Either a five-horsepower motor drive or a belt drive can be supplied. Eight sizes of this machine are built, ranging from 76 to 144 inches.

CHARD MULTI-SPEED MOTOR- OR BELT-DRIVEN LATHE

A motor- or belt-driven lathe in which the four highest speeds are transmitted direct to the spindle without using gears in the headstock, has recently been developed by the Chard Lathe Co., Newcastle, Ind. In addition to these four speeds, eight speeds are obtainable through headstock gears when heavy cutting is desired. The lathe can be driven direct from a lineshaft or by any kind of a motor.

The four highest speeds are obtained through a gear-box cast integral with the headstock lathe. On this gear-box there is a bracket for mounting the motor, power being delivered from the motor to the gear-box by a silent chain. A wide belt, or a second silent chain, is employed to transmit the power from the gear-box to the spindle. All shafts in the gear-box are provided with ball bearings and run in a bath of oil.

The spindle driving pulley is mounted on a sleeve that fits the spindle. Two gears are keyed to this sleeve for transmitting power to gears on the back-shaft, the latter gears having clutch teeth cut on



Chard Multi-speed Motor- or Belt-driven Lathe

their hub faces. Clutches slide on keys to engage either of the gears on the back-shaft. At the extreme right-hand end of the back-shaft, there is a pinion gear which slides in and out of a large gear by means of the lever at the right of the headstock. For a direct-spindle speed, this lever is moved to the left to disengage the pinion gear from the large gear and to engage the sliding clutch with a clutch on the pulley sleeve, which causes the gears on the back-shaft to run idle. When speeds are desired through the back-gears, the right-hand lever is moved to the right to engage that gear on the back-shaft which is selected by using the lever at the left-hand end of the headstock.

NAYLOR "SPIRALWELD" IRON PIPE

The Naylor spiral lock-seam pipe described in July, 1926, MACHINERY at the time it was placed on the market by the Naylor Spiral Pipe Co., 1230 E. 92nd St., Chicago, Ill., was designed for use under low or medium pressures in the conveying of various substances. The same company has now produced a "Spiralweld" pipe in which the spiral four-ply seam is welded to the pipe wall to give additional strength. This pipe is made of Toncan iron, which does not rust materially from acids or alkalies. The new pipe may be used under high pressures.

"Spiralweld" pipe is made to wrought iron standards, in sizes from 4 to 12 inches and in 20-foot lengths. Threaded ends can be provided for standard screw fittings, and flanged ends for standard flange fittings.

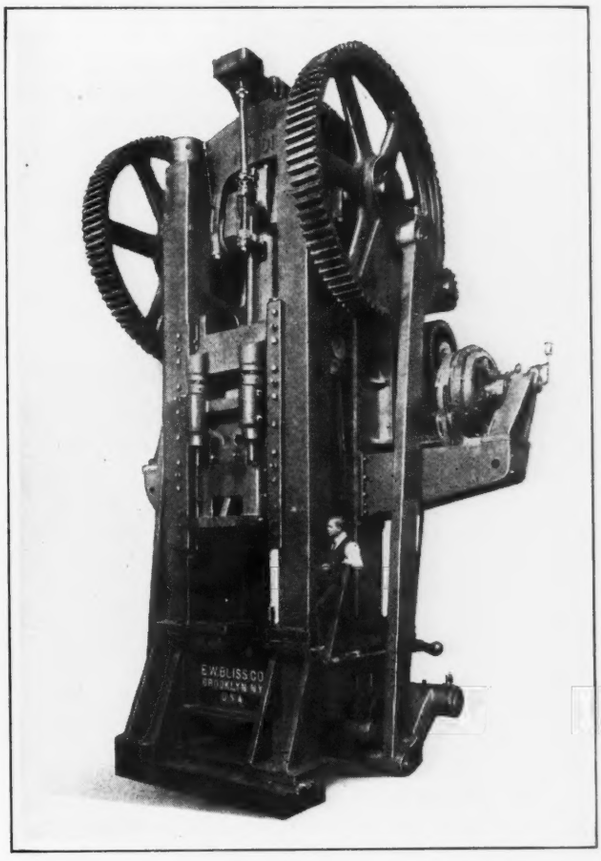
BLISS HUGE DOUBLE-ACTION PRESS

The largest single-crank double-action press ever built by the E. W. Bliss Co., Brooklyn, N. Y., is shown in the accompanying illustration. This press is of a special type and weighs approximately 400,000 pounds. It has a crankshaft 18 inches in diameter at the bearings, and 21 inches in diameter at the crankpin. The press will draw and lift out work up to a depth of 11 inches, and is adapted for cutting and drawing heavy metal. It is of a tie-rod construction in which the entire working strain is taken by four large steel rods which tie together the crown, bed, and uprights.

The press has a capacity of 1000 tons, 500 tons on the blank-holder and 500 tons on the plunger. If desired, the inner and outer slides can be locked together and the machine used as a single-action press for work requiring a pressure of 1000 tons. This change is made merely by driving two pins through the blank-holder and plunger slides and by simultaneously removing two keys in the connecting-rods.

When used as a double-action press, the blank-holder is operated by long links inside the housing, which are connected to a crankshaft in the bed. This second crankshaft is driven by the main gears through a toggle motion. It has four crankpins, two of which are used to operate the blank-holder and two to operate the positive lift-out in the bed. Adjustment of the blank-holder is accomplished by means of four large adjusting screws, while the plunger is adjusted through a 15-horsepower motor mounted on the crown.

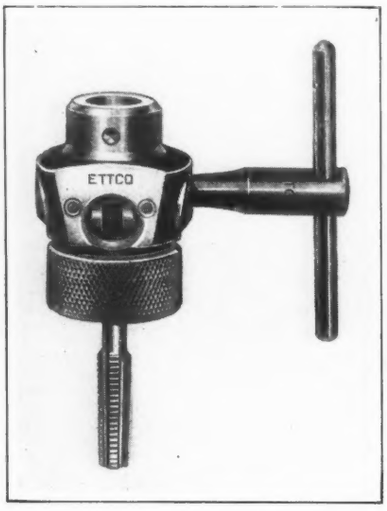
The machine is driven by a 125-horsepower motor, is triple-geared, and has a twin drive. Some of the principal dimensions are as follows: Distance between housings, 60 inches; distance from bed to blank-holder with the stroke down and the adjustment up, 42 inches; maximum distance from bed to plunger, 48 inches; stroke of blank-holder, 11 3/8 inches; stroke of plunger, 24 inches; stroke of knock-out, 11 3/8 inches; adjustment of plunger, 8 inches; adjustment of blank-holder, 8 inches; and adjustment of knock-out, 7 inches.



Bliss Double-action Press which Weighs 400,000 Pounds

"ETTCO" TAP-HOLDING CHUCKS

A new line of tap-holding chucks has been added to the tools manufactured by the Eastern Tube & Tool Co., Inc., 590 Johnson Ave., Brooklyn, N. Y. The square end of the tap shank is gripped and held from rotation by two floating jaws, while three lower jaws center the tap. Visibility is one of the features pointed out for these chucks, it being possible for the operator to see the two floating jaws actually gripping the square end. These jaws are tightened with a key, and are operated by means of right- and left-hand threads. The jaws are free to float transversely. The three lower centering jaws are closed by means of the knurled collar.



"Ettco" Tap-holding Chuck of New Design

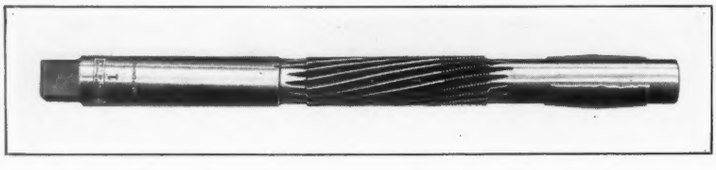
Three sizes of these chucks are now made—the No. 1 size having a capacity for 1/4-inch round shanks and 3/8-inch taps; the No. 2 size, for 3/8-inch round shanks and 1/2-inch taps; and the No. 3 size, for 1/2-inch round shanks and 5/8-inch taps. Two larger sizes are being designed.

These chucks can be furnished with the backs threaded, tapered, or equipped with Morse taper shanks. Provision is made for pinning threaded shanks securely in place. The chucks are also manufactured with the back extended 1 inch, so that they can be used in the tap-holders of screw machines in a manner which eliminates many tap bushings. Drills, reamers, and other tools can be held if a flat is ground on the round shanks.

REIFF & NESTOR FLOATING-PILOT SELF-FEEDING REAMERS

Spiral expansion reamers possessing a self-feeding feature and equipped with a floating pilot which insures correct alignment during use are being placed on the market by the Reiff & Nestor Co., Lykens, Pa., in various sizes ranging from 5/8 to 1 1/2 inches in diameter. The floating pilot, which may be seen near the right-hand end in the illustration, is tapered on the outside to fit any size of hole within the range of the reamer and thus accurately guide the tool during an operation.

The reamer is particularly useful in finishing piston-pin holes to receive either over-size or standard-size pins and in reaming connecting-rod bushings or other parts where single bushings are employed. At one end, the pilot is 0.025 inch under the standard size, and at the other end, 0.005 inch under size, while at the point where the two tapers join, the pilot is 0.025 inch over the standard size.



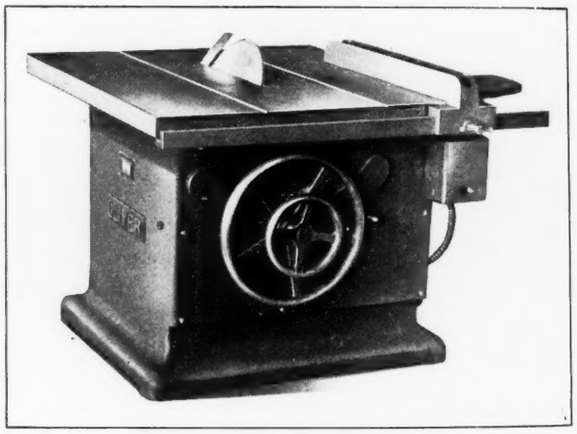
Reiff & Nestor Self-feeding Expansion Reamer with Floating Pilot

The self-feeding feature is produced by a thread cut on the flutes at the ends which commence the cutting. In addition to pulling the reamer into the work, these threads overcome chatter, readily break up hard glazed surfaces in used bushings and cut up the chips so as to lessen dulling of the tool.

The spiral flutes bridge all keyways or oil-grooves in a part and are closely spaced. They are ground from 0.001 to 0.002 inch under size. It is intended that an expansion plug be always inserted into the reamer sufficiently to support the cutting blades. An expansion screw is fitted into one end of the tool. The shank is ground 0.002 inch under size and serves as a back pilot. It is long enough to permit chucking on it when the reamer is used in a machine.

OLIVER TILTING-ARBOR SAW BENCH

A saw bench on which angular cuts are taken with the work lying flat on the table and with the saw tilted to the desired angle, constitutes the latest addition to the line of woodworking machinery built by the Oliver Machinery Co., Grand Rapids, Mich. The illustration shows the saw tilted and the machine equipped with a plain ripping fence and solid table. It can also be furnished with a universal tilting micrometer ripping fence, a universal table having a rolling section and universal gages.



Oliver Saw Bench with Tilting Arbor

The large handwheel is used for tilting the saw to the desired angle, and the small handwheel for lowering or raising the saw to project it through the table the required amount. The saw can be clamped in the tilted position. A door on the right-hand side of the machine affords access to the inside of the column for any adjustment of the gibs, gib screws, or tilting mechanism. The motor head of the saw arbor is equipped with ball bearings and is grease-lubricated by the Alemite system. Saws up to 18 inches diameter can be mounted on the machine, but it is regularly equipped with 14-inch saws.

MARDO ELECTRICALLY DRIVEN AIR PUMP AND SPRAY GUN

An electric motor driven air pump and a spray gun have recently been placed on the market by Demco, Inc., 105-115 S. Calvert St., Baltimore, Md., under the trade name of "Mardo." These devices are intended for use with the "Mardo" purifier for painting and spraying operations. The pump, which is illustrated in Fig. 1, is of the single-cylinder type, and is equipped with a motor which may be operated from any convenient light socket. The cylinder has a capacity of 1 1/2 cubic feet of free air per minute. A conical-shaped water jacket or reservoir surrounds the cylinder to give a water-cooled unit. The pump is fitted with a convenient handle, which makes it readily portable, the total weight being only 40 pounds. The pump is guaranteed for any pressure up to 75 pounds per square inch, and is capable of delivering a higher pressure under overload.

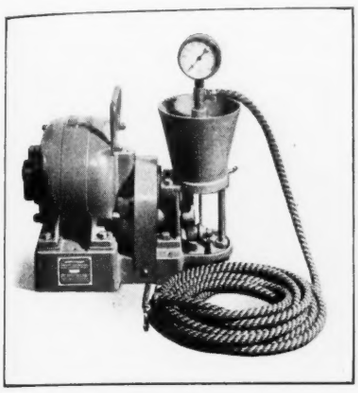


Fig. 1. "Mardo" Electrically Driven Air Pump

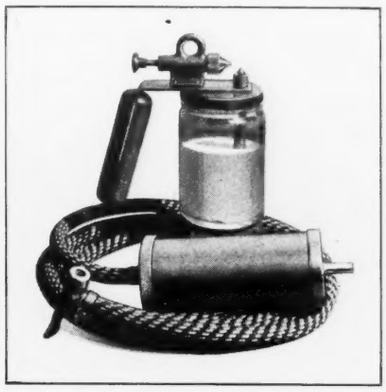


Fig. 2. "Mardo" Spray Gun Used with Pump Shown in Fig. 1

The "Mardo" spray gun is shown in Fig. 2. It is arranged with an automatic vent so that it is not necessary to use a storage tank or other accessory when painting or spraying. The purifier has one end threaded, so that a cap may easily be removed for cleaning when it becomes saturated with moisture and dust taken from the air. Two sizes of nozzles are furnished with each spray gun to take care of light or heavy liquids, and ten feet of hose and thumb-lock connector are also supplied.

SIX-FOOT EXTENSION ADDED TO LARGE PLATE ROLLS

An unusual job was recently accomplished by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill., when a set of 34-foot plate rolls in the shops of the General American Tank Car Corporation at East Chicago, Ind., was lengthened to 40 feet. The original machine, a Ryerson-Kling bending roll, had a capacity for sheets 34 feet 2 inches wide by 3/4 inch thick. It had an upper roll 29 inches in diameter and two 20-inch lower rolls.

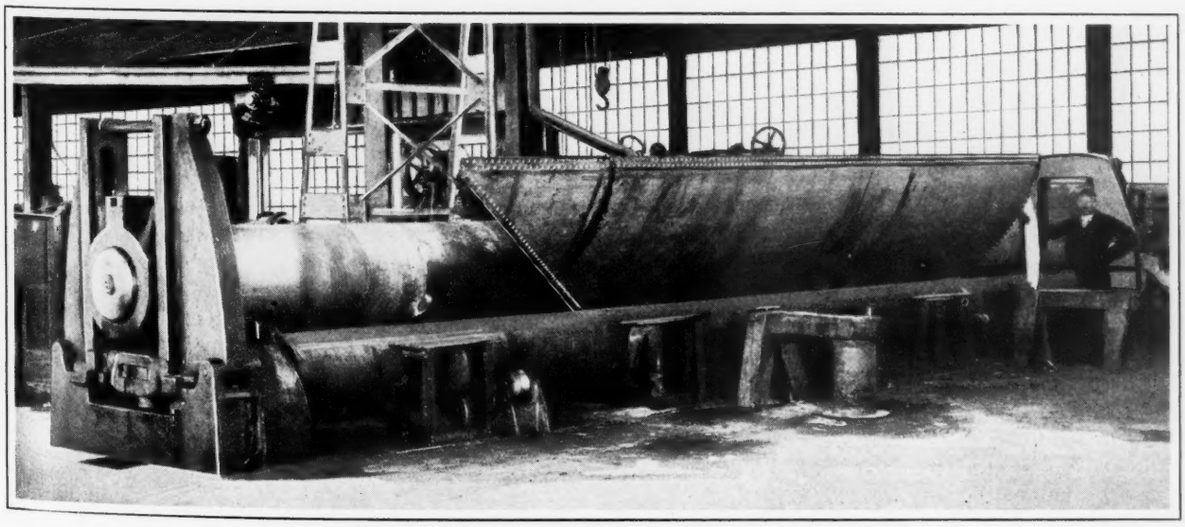
In making the change, it was necessary to dismount the rollers, extend the base, and move out the rear housing. The six-foot extensions, made of Mayari iron, were slipped over the journals and welded along the circumference of the joints. Additional center support was placed at the joints of the lower rollers.

A subsequent order calling for the rolling of 200 plates, 1/2 inch by 8 feet by 38 feet, to a radius of 34 inches, paid for the extension of the machine and netted a substantial profit as well. If it had not been possible to enlarge the rolls, it would have been necessary for the concern to buy the plates, fabricate them, ship them to Pittsburg for rolling, and reship them to East Chicago at fabricated steel rates.

* * *

HACK SAW MANUFACTURERS' ASSOCIATION

A new trade association known as the Hack Saw Manufacturers' Association of America has recently been formed. Daniel W. Northrup, president of the Henry G. Thompson & Son Co. of New Haven, Conn., has been elected president of the association. William E. Cross and Carl G. Davis are vice-presidents, and Phillip Rogers, treasurer. The association is now functioning, and through co-operation with the Department of Commerce in Washington, it is hoped that many improvements in the industry will be effected.



Large Set of Plate Rolls Increased Six Feet in Length

NEW METHOD OF ELECTRIC WELDING

The Lincoln Electric Co., Cleveland, Ohio, announces that a new method of electric welding has been discovered in the research laboratories of the company; this new method is termed the electronic tornado press. It is stated that the welds produced by this process are more uniform in structure and

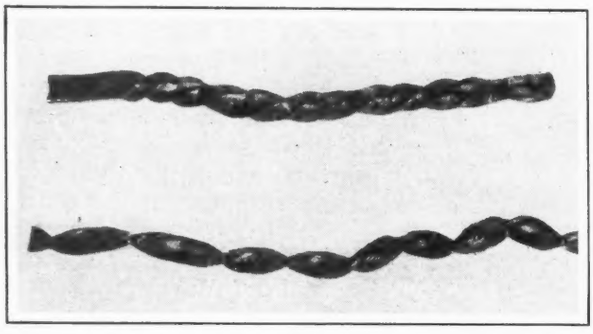


Fig. 1. Strips of Welded Plate, Twisted to Test Quality of Weld

ductility than welds formerly produced, and that the cost of welding is much less than by present methods. As an example, it is mentioned that the cost of welding 1/2-inch plates, including the operator's time, electric current and carbon electrode, does not exceed three cents per running foot of weld.

The process, according to present developments, will not affect the manual arc-welding process, but it is believed that all welding that can be performed automatically will be materially decreased in cost. Among the possibilities for the new process are

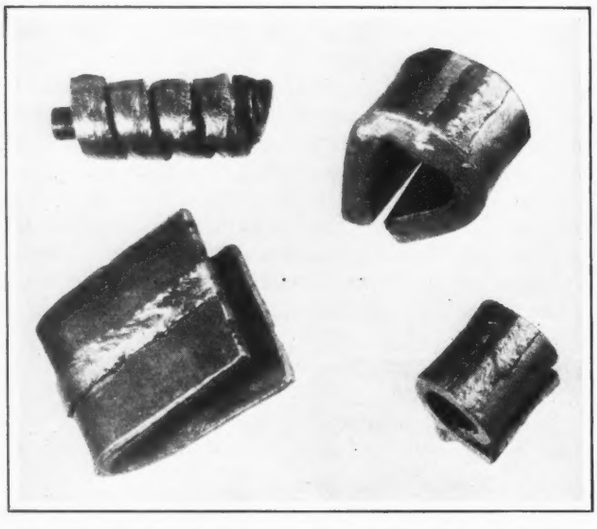


Fig. 2. Different Tests to which Welds Made by New Electric Arc Welding Method have been Subjected

mentioned freight cars, oil storage tanks, pipe lines, and box girders for buildings.

Fig. 1 shows test pieces made by this method from 1/4-inch and 1/2-inch plates. The welds were sawed from the plates and the resultant bars twisted three complete revolutions, as shown. No indications of failure of the weld can be detected. A smooth finish is also said to be one of the advantages of the process. The smoother finish on the welding bead is due to the higher speed of travel of the welding heads in this process.

In order to test the claim that welds made by this method have as great tensile strength and ductility as the parent metal, parts so welded have been subjected to every kind of test, as indicated in Fig. 2, and it is stated that the results have been uniformly satisfactory. The machine used and the actual details of the process have not, as yet, been made public.

* * *

STUDYING MOVING MACHINES BY MOTION PICTURES

At the annual meeting of the Society of Automotive Engineers, C. Francis Jenkins of the Jenkins Laboratory, Washington, D. C., described a slow-motion camera that makes exposures at the rate of 3200 per second. When these are projected on the screen at the standard rate of sixteen pictures per second, the speed of the original movement of the subject shown is only 1/200 of the actual speed. The film passes through the camera at the almost incredible speed of 200 feet per second, yet the pictures are said to have real photographic qualities and to be as clear as other motion pictures. The new camera affords a means for the study of many problems in science and engineering, some of which it has not been feasible to study properly in any other way. Among the applications suggested are the study of airplane propellers and landing gear action, the action of automobile tires in passing over obstructions, engine valve action at high speed, cam roller action, and crankshaft "whip."

* * *

SHIPPING RUSH ORDERS BY AIRPLANE

Various expedients and modes of transportation have been employed at different times by Joseph T. Ryerson & Son, Inc., to get a rush order of steel through to a customer. One of the most interesting records for quick delivery was made recently when a rush order for five pounds of rivets was received by wire from a construction company late one afternoon. The rivets were quickly packed and rushed to the American Railway Express Air Station in time to catch the next outgoing airplane express. One hour and fifty minutes later the rivets were thrown out at their destination 236 miles away, where they were used the same night. This incident illustrates one of the possibilities of the airplane for industrial use.

* * *

NEW TYPE OF CIRCULAR WIRE BRUSH

A new type of circular wire brush for use in scratchbrushing, cleaning and rough-polishing has recently been brought out by the Specialty Mfg. Co., 10698 Berea Road, Cleveland, Ohio. In this wire brush the wires, which may be of different materials, are held in place on an accurately balanced lead center by means of two stampings provided with projecting teeth, which pass through the tufts of wire from each side and also through holes provided in the plates. After assembling, the projecting ends of the teeth are bent over and clinched tightly against the surface of the opposite stamping. In this way, the tufts cannot become loose even after long use.

THE BRITISH METAL-WORKING INDUSTRIES

From MACHINERY'S Special Correspondent

London, January 15, 1928

On the whole, the year 1927 was a satisfactory one in the British metal-working industries, and marked a period of consolidation, free from serious industrial troubles. Conditions in the machine tool industry continue to vary considerably in different districts; but, speaking generally, makers report that orders in hand are satisfactory, even if they do not in many cases insure employment for more than the immediate future. Machine tool makers who specialize in tools for the automobile and railway shops are in the most satisfactory position, both as regards present orders and prospects for the future.

On the other hand, makers who are largely dependent upon the shipbuilding and heavy engineering industries, find that there is a general reluctance to sanction expenditure for new tools beyond the bare needs of the moment, despite the fact that conditions, particularly in the first of the industries mentioned, are distinctly promising. This caution has doubtless been born of experience during recent years when more than one heralded trade revival has come to nothing.

Overseas Trade in Machine Tools Improves

The figures for overseas trade in machine tools during November are very encouraging. Exported tonnage rose from 1191 in October to 2018, the latter figure representing the highest monthly total since April, 1921, when approximately 2300 tons were exported. The highest total recorded since January, 1920, was reached in December of that year with 2940 tons.

The equivalent value of last month's exports was £197,581 as compared with £152,232 in October, the former figure being the highest since July, 1921, when the total reached £240,000. The peak value since January, 1920, coincided with the maximum tonnage month, namely, December of that year.

At the same time a slight decrease in imported tonnage is noticeable, the November figure being 707 tons, as compared with 803 tons in October and 985 tons in September, the corresponding monthly values being £109,180, £113,804, and £132,940, respectively. By comparison, it is interesting to note that imports during December, 1920, amounted to some 700 tons, valued at £175,000.

When the exceptional month of November is merged into the eleven months total, the results in exports are 1 per cent above standard in tonnage and 10 per cent below in value, the standard being the average of 1921-1924, and since prices have certainly fallen, this indicates an improving tendency.

Developments in the Railway Engineering Field

The hopes of railway engineering firms in this country that they would obtain the bulk of the orders from South Africa for locomotives to a total value of £1,000,000, will have been rudely dashed by the news that 90 per cent of the contract is likely to go to Germany on account of the fact that the German bids were 25 per cent lower than those of British firms. There is, however, no reason for depression among railway engineers, as the principal railway companies, doubtless spurred on by the growing competition of road transport, are sparing no efforts to bring their services up to date.

One of the main tendencies during the past year has been the increase of non-stop passenger train runs at high speeds, among which may be mentioned the 300 mile non-stop run from London to Carlisle, and there is no doubt that in this sphere the railways are safe from serious road competition for many years to come.

It may also be recalled that 1927 saw the inception of the "King George V" class of locomotive by the G. W. R. engineers. These engines have a tractive force of 400,000 pounds, while the boiler pressure has been raised to 250 pounds. One of these engines was sent to America for the Centenary Exhibition of the Baltimore and Ohio Railroad, and made a number of runs on American railways.

Electrical Engineering Industry is Well Employed

The electrical industry, more particularly the heavier branches of that industry, remain well employed, and it is safe to prophesy that conditions in this country will be eminently satisfactory for several years to come. Not only is there a steady and growing export market, but the industrial advantages of cheap electrical power in this country are becoming more fully realized, and a number of large power stations are under construction.

During November of last year electrical exports reached the highest monthly total of the year with £1,770,978, the previous highest figure, reached in January, being £1,710,258. The November export showed an increase of £292,981 by comparison with October, and of £45,757 by comparison with November, 1926. Imports for November with £602,980 show a slight decrease, namely, £4717 by comparison with the October figure, but are substantially larger than the November, 1926, total of £525,878.

Automobile Industry Looks Forward to a Busy Year

Automobile manufacturers are generally anticipating a busy year during 1928, and particularly those concerned with popular priced light cars. In a paper read recently before the Institution of Automobile Engineers, C. R. F. Engelbach of the Austin Motor Co. gave it as his opinion that the saturation point will not be reached in England until there is one car to every twelve of the population. If this result is to be attained, it involves the manufacture of some 2,000,000 more cars, which at the present rate of production, plus a steady yearly increase, is sufficient for nine or ten years work without taking into account the replacement of scrapped cars.

These figures, of course, do not include the possibilities of the export market, particularly in Australia, which is now regarded as being of such importance that the substantial deficit registered by one well-known British automobile firm during 1927 was largely attributed to depressed conditions in Australia, due to sheep and dairy farmers having been badly hit by droughts.

PERSONALS

H. M. SWIGART was elected president of the Oilgear Co., 655 Park St., Milwaukee, Wis., at a recent meeting of the board of directors. E. K. SWIGART was elected chairman of the board.

J. W. ROCKEFELLER, JR., formerly factory manager of John Chatillon & Sons, 99 Cliff St., New York City, is now engaged in the practice of consulting engineering, with offices in the Woolworth Building, New York City.

Edward Bausch

EDWARD BAUSCH, president of the Bausch & Lomb Optical Co., Rochester, N. Y., has been elected an honorary member of the American Microscopical Society in recognition of more than fifty years of active interest in microscopy. In 1876, the first Bausch & Lomb microscope was exhibited at the Centennial Fair in Philadelphia—the work of Edward Bausch, then fourteen years old, who had constructed this first model to satisfy his curiosity as to what he could do with a microscope of his own make. Ever since that time Mr. Bausch has been actively interested in the production of microscopes, and the contribution of Mr. Bausch and of the Bausch & Lomb Optical Co. in this field has been most noteworthy.

HERBERT W. CALDWELL, who has been with the Cleveland Stone Co., Cleveland, Ohio, since its incorporation in 1886, starting as bill clerk, was elected president at the last annual meeting.

L. A. QUINN, who has been acting manager of the Birmingham, Ala., office of the Niles-Bement-Pond Co., 111 Broadway, New York City, has been made sales manager for the Birmingham district.

S. W. CALHOUN has recently joined the sales organization of the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill., and has been appointed southeastern district representative, with headquarters at Ashville, N. C.

FRANCIS A. EMMONS, sales manager of the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill., has been elected a director of the Power Transmission Association and appointed a member of the Merchandising Advisory Committee of the association.

JOHN VAN HORNE has been transferred from the Atlanta office of the Lincoln Electric Co., Cleveland, Ohio, to Moline, Ill., where he will be located at 514½ Fifteenth St., and will have charge of the sale of "Linc-Weld" motors and "Stable-Arc" welders in the Tri-cities.

FRANK E. ARTZ, 23 S. Jefferson St., Chicago, Ill., has been appointed sales representative in the Chicago territory for the General Mfg. Co. of Detroit, Mich., builder of flexible power presses. The Chicago territory includes northern Illinois, northern Indiana, Wisconsin, and Iowa.

A. J. BROSSEAU, president of the Mack Trucks, Inc., has been appointed chairman of the Motor Truck Committee of the National Automobile Chamber of Commerce. Mr. Brosseau has been elected vice-president of the Commercial Car Division of the Chamber, and is also a vice-president of the United States Chamber of Commerce.

EUGENE D. MILENER, who has been with the Consolidated Gas Electric Light and Power Co., of Baltimore, Md., for several years, is now industrial gas research representative of the American Gas Association, 420 Lexington Ave., New York City. Mr. Milener is a graduate of the Baltimore Polytechnic Institute and the University of Maryland.

M. J. SCHMITT, formerly in charge of the Milwaukee Branch of the Kearney & Trecker Corporation has been promoted to the new position of assistant sales manager. Mr. Schmitt will continue to look after the Milwaukee territory, with the assistance of R. F. Shaw, who is being transferred from the Chicago branch to the home office at Milwaukee.

GEORGE F. ANGLIN, for the last four years Pittsburg manager of the Torrington Mfg. Co., Torrington, Conn., and the Blake & Johnson Co., Waterbury, Conn., before its merger with the former concern, has joined the machinery and equipment sales department of Mackintosh-Hemphill Co., Pittsburg, Pa., manufacturer of rolling mills and rolling mill equipment.

A. A. ROSENFELDER, for the last nine years manager of the machine tool department of the Peden Iron & Steel Co., Houston, Texas, has organized a business located at 4620 McKinney Ave., Houston, for the sale of machine tools and shop supplies in the southern half of the state of Texas. Mr. Rosenfelder wishes to acquire additional lines of machine tools and supplies for sale in this territory.

PAUL H. PETERSEN, Graybar Building, New York City, export manager and foreign trade representative for Joseph T. Ryerson & Son, Inc., Chas. F. Elmes Engineering Works, the Curtis & Curtis Co., and other well-known American manufacturers, announces that his organization has been expanded to handle exports of mechanical equipment for automotive shops, service shops and garages.

GEORGE W. MC INTYRE has been appointed New York representative of a direct sales office to be opened by the Reed-Prentice Corporation, Worcester, Mass., at 75 West St., Evening Post Realty Building, Room 1508, New York City. Mr. McIntyre was connected with the Niles-Bement-Pond Co. for many years, and will cover the sale of the complete line of machine tool equipment and Wolf portable timber sawing machines in the New York territory.

GEORGE L. POLLOCK, vice-president and treasurer of the Burnside Steel Foundry Co. since its organization, has resigned to become vice-president of the Nugent Steel Castings Co., Chicago, Ill. Prior to becoming associated with the foundry industry, Mr. Pollock had been with the purchasing department of the Burlington Railroad and later served as purchasing agent of the Wheeling and Lake Erie Railroad and the Chicago and Western Indiana Railroad and Belt Railway Co. of Chicago.

H. F. T. ERBEN, assistant vice-president of the General Electric Co., Schenectady, N. Y., retired on January 1 after more than forty years' service with the company. At the time of his retirement he was also vice-chairman of the General Electric manufacturing committee. B. L. DELACK has been appointed manager of the Schenectady plant of the company, and E. A. WAGNER has been appointed manager of the Pittsfield, Mass., plant. Announcement is also made that C. N. GREGORY has been appointed manager of the New Haven office, succeeding FREDERIC CUTTS, and R. B. RANSOM has been appointed resident agent in charge of the Hartford office, succeeding Mr. Gregory.

A. H. GRAYBURN, formerly assistant secretary and assistant treasurer of the Norma-Hoffmann Bearings Corporation, Stamford, Conn., has become associated with the Hope Engineering & Supply Co., Mount Vernon, Ohio, in an executive position. A. H. RITTER, New York district manager of the Norma-Hoffmann Bearings Corporation, has been transferred from New York to Stamford as assistant secretary, and will be succeeded in the New York office by F. W. MESINGER, formerly located at Stamford. NORMAN BELL, assistant sales manager, has also been made assistant secretary. E. C. LENON, of the Stamford office, will be in charge of orders, shipments, credits, and collections.

J. L. DAVIDSON, exhaust foreman of the Westinghouse Lamp Co.'s plant at Bloomfield, N. J., was recently decorated with the Insull Medal for Resuscitation. The medal was presented to Mr. Davidson by A. L. Van Brunt, director of safety education of the Public Service Gas & Electric Corporation of New Jersey, on behalf of Samuel Insull, the donor of the medal, and the Accident Prevention Committee of the National Electric Light Association. Mr. Davidson received the medal because of his action in saving the life of a fellow worker. Last February at the risk of his own life, he went to the aid of John McDonald, an electrician, whose head accidentally struck a magnetic contactor on the machine which he was repairing, thus allowing 5200 volts of electricity to pass through his body. Mr. McDonald's arms were locked tightly around the angle-iron frame of the machine on which he was working, and Mr. Davidson was obliged to use force to ply his arms free of the metal work, thereby taking the chance of being shocked himself. He then immediately applied the Schaeffer method of resuscitation. After fifteen minutes' work, Mr. McDonald showed signs of life and in twenty-five minutes he began to breathe.